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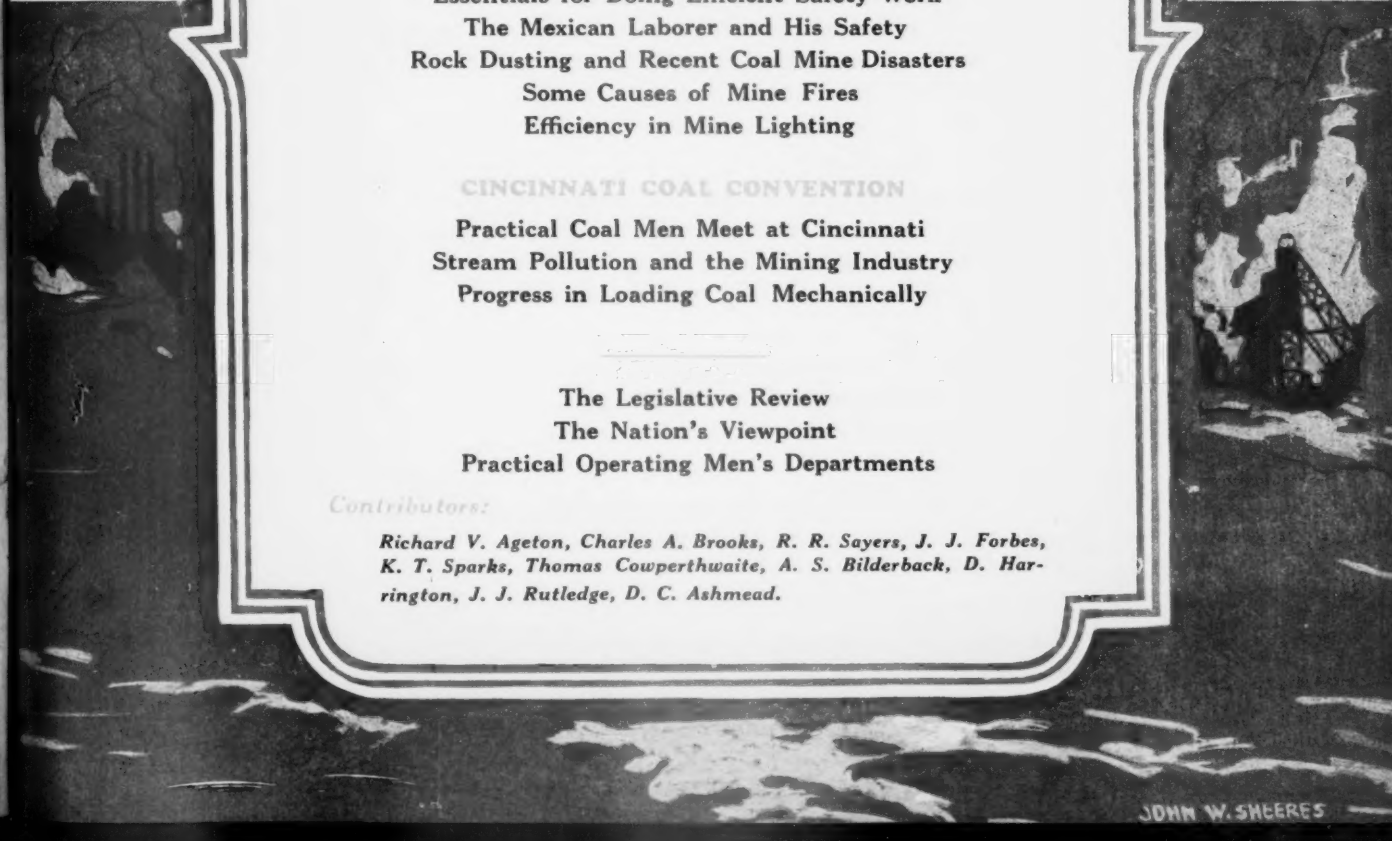
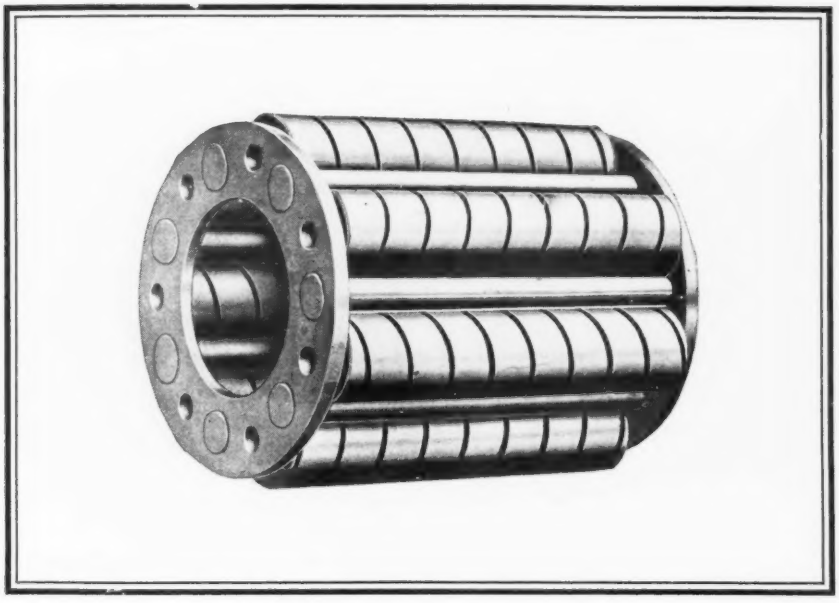
Contributors:

Richard V. Ageton, Charles A. Brooks, R. R. Sayers, J. J. Forbes, K. T. Sparks, Thomas Cowperthwaite, A. S. Bilderback, D. Harrington, J. J. Rutledge, D. C. Ashmead.





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JUNE, 1926

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COAL

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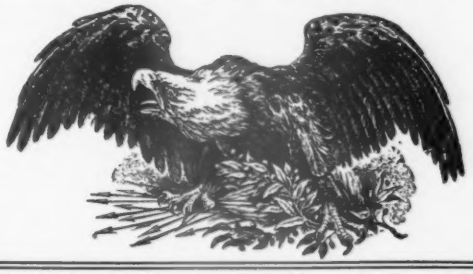
GUY N. BJORGE
Associate Editor



NEWELL G. ALFORD
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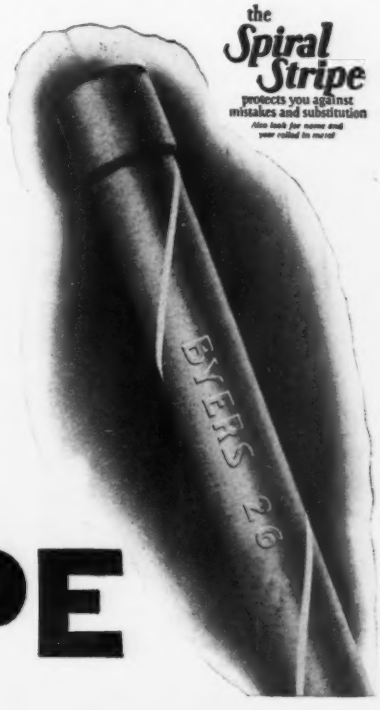

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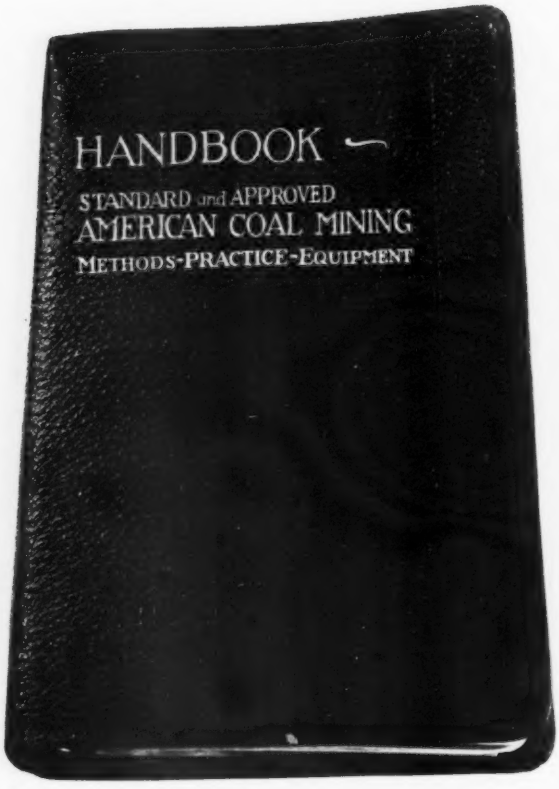

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STANDARDIZATION DIVISION
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National Photo

I. Pridgeon

Dogwood in the Zoological Park, Washington.

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REAL PROGRESS

WHILE the United States Congress has been busily engaged in discussing pro and con legislative medicine to relieve the so-called coal "situation," the industry itself has been holding a congress of its own, discussing practical ways and means to find still further methods of cost reduction through the use of mechanical equipment and efficient mining systems. The country has been afflicted with an epidemic of propaganda from that school of thought that is convinced that the coal industry is the worst functioning industry in this country. This sort of criticism is entirely out of place when applied to the production end of the industry.

Attendance at the Cincinnati meeting would convince the most skeptical of individuals on that score. More than a thousand operators came to the Cincinnati meeting solely for the purpose of discussing the every day problems that must be met in coal production. Operating officials as well as executives of an amazing number of coal properties, representing practically every coal producing district, were in attendance. It is inevitable that the influence of this convention upon the future progress of the coal industry will transcend that of any previous meeting of its kind. The program was excellent, covering thoroughly many of the operating problems that the industry is striving to overcome. It was carried out with unexcelled dispatch under the leadership of able chairmen, with the cooperation of the best informed men of the industry, all of whom gave willingly of their experience in working out these problems. To a program committee, composed of 35 coal mine operators, should go the thanks and appreciation of the industry for the excellent result of the Cincinnati program.

The interest of the industry was apparent. Problems were approached in a big, broad manner and discussed upon common ground. There was a common purpose: that of getting into the proceedings the ideas of the best minds of the industry on each of the subjects discussed. The results to be obtained from this meeting may come gradually, over a considerable period of time, but they will begin to be felt in every coal mining district from the moment the delegates return to their respective duties. Companies that in previous years sent two or three men, brought many times that number this year. Coal mine management has learned that a trip to these meetings for their men brings a return that cannot be reckoned in dollars and cents. They have learned that the men return to their jobs filled with new ideas; they have learned that the other fellow is doing things too, and they go back to their duties better informed and more valuable men.

Increased efficiency in operations, reductions in mining costs, keen appreciation of the cooperative attitude of operators, a clearer understanding as to just where the industry is heading in solving its operating problems—these are major results that are certain to accrue to the industry from this meeting. These conclusions seem inevitable after being in such an atmosphere among such an aggregation of men of outstanding abilities, and through such an instructive series of discussions as characterized the Cincinnati meeting. If coal operators, labor organizations, and the Congress of these United States would carry out their deliberations with the same common purpose and unselfish intent to recognize the truth and work out the solution of what may be termed the political problems of the coal industry, these problems would soon disappear.

This is the ultimate goal for which the American Mining Congress is striving in its effort in behalf of the mining industry, and these annual meetings at important coal centers are steps in the right way.

PRODUCTION EFFICIENCY

P. H. PENNA told the delegates to the Cincinnati meeting that there is no coal problem. And while we may not agree with him, and while most certainly the United States Congress does not agree with him, Mr. Penna made a real case for coal in his talk at the informal dinner during the Cincinnati meeting.

He decried the sob-sisters, male and female, that stand on the corners, in the highways and by-ways, in the corridors of Congress, and in the marts of the world, yelling that coal is a poorly functioning industry. He defied those present to point out just one single industry that is analagous in magnitude to the coal industry, that approaches it in production efficiency.

To that extent we are with Mr. Penna heart and soul. We know of no other industry that goes after its problems with the same intelligence, the same persistence, the same keen understanding as the coal industry does in solving its practical operating problems, in giving to the world the largest volume of coal at the lowest price.

At Cincinnati more than a thousand operators gathered, purely for the purpose of *helping* each other. Ten years ago the idea of one operator giving his competitor the results obtained through the adoption of some new mining methods, through the installation of lavor-saving cost reduction equipment, was unheard of. At these annual meetings operators not only give each other information concerning the type of equipment they are using, the results they are obtaining with that equipment, but frequently the savings in dollars and cents are available to the industry.

Is there another industry that is doing what the coal industry does at its annual meetings of practical operating officials, held for the past three years at Cincinnati? If there is, we do not know of it. If Congress and the rest of those so anxious to graft their theories upon the coal industry, will give that industry half a chance, it will do with its economic problems just what it is doing with its practical operating problems.

The industry should adopt a new slogan and enforce it, and the burden of that slogan should be self-government. Coal has a problem—in fact, many problems—no matter who is responsible, and it will solve them to the satisfaction of all concerned if it is given time and its shackles are removed.

SHACKLING THE PUBLIC DOMAIN

WHEN the Western States were admitted to the Union they were not given jurisdiction over the public lands within their boundaries; but the theory on which they were ultimately to become sovereign as to ownership and taxation was the gradual acquirement, by purchase or under the homestead and mineral laws, of these public lands by private owners. In this manner the states of the Mississippi Valley all have become sovereign, as the public lands within their borders at the time of their admission have since passed to private ownership.

Between the close of the Revolutionary War and the year 1867 the United States acquired by treaty, by purchase, and by annexation 2,315,310,720 acres of land, exclusive of island possessions. The total consideration was $52,209,000. The total acreage sold by the United States, exclusive of Alaska, is 1,053,604,081, and the total amount paid into the National Treasury $565,998,092.17. The rapid development of the mining and agricultural industries as the result of the liberal policy of the Federal Government in the past has made the United States the greatest world power, the economic wealth thus created is enormous, and the public-land states have prospered.

It apparently is now the policy of the Federal Government to extend its authority over the public domain in such a manner as to place private use and development of the remaining public lands under Federal regulation and control. Millions of acres of unappropriated public lands have been placed under the leasing system whereby the Federal Government retains permanent control to the exclusion of state authority which would take jurisdiction if these lands passed to private ownership. Private enterprise, therefore, is deprived, to a large degree, of initiative in developing whatever value may exist in these lands, and the states in which the remaining lands are situated are deprived of taxes.

The mining industry has been the chief sufferer from the present shortsighted policy of the Federal Government; but legislation now pending probably would place the stock-raising industry in a similar position. One of the bills being considered in Congress proposes to enlarge the jurisdiction of the Secretary of the Interior over unappropriated public lands still remaining, and those opposing this legislation contend that this bill would put the Federal Government still further into business operations, into Federal exactions of fees, charges, tributes, and levies, and that it will practically stop all settlement and development and hopes of private ownership.

The enlargement of the leasing system—the substitution of this system for private ownership—can only result in the curtailment of development and settlement of the public domain, and the loss of needed taxation revenue which otherwise would accrue to the public-land states. Withdrawals made by the Federal Government in comparatively recent years have placed millions of acres under the jurisdiction of the Forest Service of the Department of Agriculture, and a system of regulation has been established which has discouraged, and, in fact, has practically stopped, all prospecting for and development of minerals within the areas included in the withdrawals.

There is serious danger that the present policy of the Federal Government will lead to legislation that may forever deprive the Western States of the benefits of private ownership, development, and taxation of approximately one-third of the area within their borders. The mining industry is unalterably opposed to such a policy, and it should be apparent to all the people that such a policy is inimical to the best interests of the country as well as contrary to the principles upon which the Federal Constitution is based.

The public-land question is one of the most important issues before the country. Dissatisfaction with the present policy of the Federal Government has become general throughout the public-land states. Numerous bills have been introduced in the House and Senate which deal with various phases of the subject, but none represents a well-defined and constructive policy, none meets with general approval, and none embraces the elements necessary to a proper solution of the question. Thus, in order to secure proper legislation and to compel the Federal Government to return to a policy based upon sound constitutional principles, the mining and agricultural industries should combine their forces in an effort to accomplish these results and to prevent the placing of shackles upon future development of mining and agriculture in what is now the public domain.

ANOTHER INVESTIGATION

THE investigation of the Federal Tariff Commission by the Senate is much like other recent investigations. Opportunity is being given for partisan discussion that may develop material for the tariff phase of the next political campaign. Some of the members of the commission appear to believe that a Republican President has been attempting to interfere with the work of the commission, while other members hold the opposite view. Some of the members have expressed the opinion that it was improper for any member to hold conferences with the chairman of the Senate Finance Committee on any item under investigation by the Commission, while at the same time these same members admit having held conferences with a Senator or Senators whose views on the subject of the tariff were opposed to those held by the other group.

This is a controversy in which the mining industry is more or less interested. Any change in the policy of Congress toward the tariff question or the flexible provisions of the present law, might jeopardize many of the rates now applying on raw minerals that must be adequately protected if the industries producing them in this country are to exist, prosper and be developed into economic units capable of fully supplying the needs of domestic manufactures. There is potential danger in the situation now existing. With members of the commission disagreeing among themselves and airing their grievances, and with an investigation going on that is certain to furnish material for dissension in Congress, the mining industry, although none of its schedules is being subjected to attack at this time, may be made a party to the dissension, through attacks upon the metals schedule.

THE LONG HARD ROAD

IN SPITE of all the evidence to the contrary the mining industry has made major strides in solving its industrial relations, or labor problem. We are speaking of the industry as a whole, not of any one branch of it. The metal mines have progressed farther than the coal mines. This is not because metal operators are more progressive, nor because of any prowess on their part, but because in the metal industry the labor problem resolves itself into an individual property question. The labor relations problem in that industry is a problem purely between the men who employ and the men who work at the various properties.

In the coal industry the question of industrial relations has resolved itself into a legislative problem. The late anthracite strike, the propaganda against bituminous coal, exaggerated by a loud-speaking minority, has convinced Congress at least that "the voice, otherwise the vote, of the nation" demands legislation as a way out. Thus we find at the present session of Congress 75 bills for the purpose of adjusting labor disputes. Only one of these has become a law—the railroad labor bill—which was signed by the President, and which is purported to be a panacea for the industrial ills of the railroads, and to be the standard to be arrived at, through legislation, for all industry.

Legislation will never solve the industrial relations problem. Common sense is the only thing that will. Selfishness is as inherent in the mine worker as it is inherent in the mine operator, as it is inherent in all humanity. Dissatisfaction is the price of all progress, and so long as there are employers and workers, just so long in some measure, will the industrial relations problem be with us. But it is a problem that may be simplified, that may be improved; that may be brought to a state of solution that will promote harmony, good will and cooperation in the mining industry.

As with safety work, understanding is the principal foundation of all industrial relations. When the men understand the management, when they come into contact with each other, misunderstandings disappear, and good will comes in. Our greatest need in all industry, and in the mining industry particularly, is cooperation. Before cooperation can become a reality understanding of each other's viewpoint is essential.

Industrial peace will never be reached through the misguided effort of legislatures whose ears are atune to political expendiency; it will not be achieved through compulsory arbitration, or through any organized minority, whether they be operators or workers, seeking to force its viewpoint. It can only be reached through an avenue that will give to the worker and the operator alike, the opportunity to gain first hand information as to the needs of the other.

Before industrial harmony is really established, if it ever is, there is a long, difficult road ahead. Progress has been made, and intelligent application, continued interest and determination, will eventually see a vast improvement, and perhaps the arrival of that much sought time when harmony will obtain in the mining industry's labor relations.

ACTION NEEDED

IT NOW appears that Congress will adjourn without passing any new railroad legislation of importance, and without undertaking to repeal the Hoch-Smith law under which the Interstate Commerce Commission is supposed to be conducting a general investigation into the rate structure of the country.

Just now the commission's activities in this investigation are confined largely to the consideration of the application of the western carriers for higher rates in the western district. This probably will result in increased rates—certainly not in reductions.

Whatever the purpose of the Hoch-Smith law, it is not being pressed by either Congress or the commission. If its purpose was that of political rate-making, to appease the farmers, it has accomplished nothing up to the present time. If its purpose was to secure an accurate and scientific study of the entire rate structure, that purpose has failed.

But, whatever its objective, the effect of having the law on the statute books has been to cause uncertainty among the railroads and shippers that cannot be otherwise than injurious. As long as the law is in force, they must anticipate that something is going to be done eventually with the rate structure—that some sort of an adjustment will be made over which they will have little or no control.

It is just a matter of time until pressure will be brought to bear upon the commission for action of some kind. The Hoch-Smith law expresses the will of Congress, and its provisions must be observed, but as long as it remains in force it will be a nightmare to shippers, railroads, and the commission.

THE ECONOMY PROGRAM

THE growing surplus in the Federal Treasury is pleasing to taxpayers. It means another reduction in taxes in the near future. It means that the economy program that has kept Federal expenditures within sound limits, and that has brought about gradually a marked reduction in the cost of Government, is bearing fruit. And it means that business is being stimulated by the efforts that have been made to lessen the burdens of taxation.

The fact that each year has shown a large surplus of revenue over expenditures has not caused any relaxation on the part of those responsible for the carrying out of the economy program. In fact, the success that has attended each year's efforts has caused the Treasury and the Bureau of the Budget to work with greater zeal to attain similar results for the current year and years to come. It is such determination on the part of Federal officials that has won for them the approbation and cooperation of taxpayers engaged in all branches of industry and commercial pursuits.

The task of reducing the Federal pay roll has not been easy. Department heads and their subordinates naturally dislike to see any shrinkage in their activities or their personnel. But the work has progressed to a remarkable degree without serious hardships upon those who have had to leave the Federal service, and without overburdening with additional duties those who remain. And, as rapidly as one phase in the reduction of Federal expenses is disposed of successfully, other phases are taken up, so that in another two years, all activities of the Government that can be dispensed with should no longer be a drain upon the taxpayers and the Treasury.

Many observers of the situation in Washington last year predicted that notwithstanding the proposed tax reductions that later were made by the Revenue Act of 1926, further reductions would be possible because the estimates of the Treasury actuaries, as in previous years, were extremely conservative and considerably below what actual results would show when the new law became effective. This prediction has become a realiza-

tion. Collections have greatly exceeded the estimates. And even the apparent slowing up of business in some directions during the current year will not jeopardize the chances for a further reduction in taxes next year.

It is a sound public policy to introduce more business in Government and less Government in business. More business in Government insures greater efficiency and economy, while Government in business, as experience has shown, leads to greater expenditures, higher taxes, and a tendency toward extravagance. It is stimulating to business to have the Government moving so rapidly toward a permanent, stable, efficient peace-time basis. It is stimulating to business to have its tax burdens constantly lessened in the careful, conservative, and permanent manner that has characterized the Government's program during the last six years. The public debt has been materially reduced at the same time, and the example that has been set for American industry and the American people is worthy of the highest praise.

SAFETY CONSCIOUSNESS

ONE of the most important phases of industrial relations work is that of mine safety. And perhaps in no other part of the mining industry's work has so much progress been made. This issue of the JOURNAL is given over largely to safety work at the various coal and metal properties. In reading these articles it is at once apparent that an entirely different attitude is prevalent in the industry. The "don't" system has been discarded for the "do" system. Indifference upon the part of men and management is rapidly being displaced by intelligent, well directed safety work.

There are many reasons for this. Perhaps chief among them is the inculcation of the competitive spirit, and the arousing of the interest of the individual miner. This spirit has been aroused through such things as Joseph A. Holmes Safety Association, the International First Aid and Mine Rescue Meets, under the auspices of the Bureau of Mines; through the Sentinels of Safety Trophy of the Explosives Engineer; through the effort of state mine inspectors; the work of communities such as the Tri-State District, and the splendid work being done by individual companies. In Utah, there is emerging an organized effort to secure the active cooperation of the mine operators, and the mine workers in accident prevention work. The State Industrial Commission has recently published a booklet with general information as to safe practice in metal mines. In every state, in every district, safety work is rapidly advancing in importance, no longer being confined to the placing of a few placards bearing the words, "Safety First." The individual mine, the community, the district, the state and the Nation are slowly but surely awakening to the possibilities in the accident prevention work. The value of the competitive idea is rapidly becoming recognized.

In the first aid meets there is real effort made to secure recognition. There is real effort on the part of workmen to secure and hold the Sentinels of Safety Trophy. And while these two events are large events that cover the entire field, the same interest is being taken at the individual properties where the spirit of competition is aroused.

There is a growing tendency on the part of management to establish some kind of safety organization at the mines. In some instances, this takes the form of committees composed of both workmen and management. Many companies have created the office of safety engineer, or some official whose duties include the creation of a safety campaign. And it has produced results. Once a company is successful in establishing and holding the interest of the individual miner in his own personal safety, in the safety of his fellow workmen, it is on the broad highway to establishing a safety record for that company. Accidents of major proportions are naturally more prevalent in the coal districts than in the metal mines. The coal industry has recently suffered several serious disasters. The coal operator is vitally interested in arousing safety consciousness among the workmen.

One session of the Cincinnati meeting was devoted to accident prevention work. Rock dusting and its possibilities were discussed. But rock dusting alone will not prevent accidents. There has been an attitude on the part of some of the workmen to feel that after a mine has been rock dusted it is accident proof; that with the installation of safety first signs all that is necessary has been accomplished. But these things are only the first feeble steps on the way up.

Whether safety of the worker shall be arrived at through national stimulation of the accident prevention idea, through the cooperative effort of the various districts producing minerals; through the competitive plan, through the activities of the state mine inspectors, through safety engineers—through any one, and through all of these sources, matters little. As with all things, if we begin at the bottom, if we teach the individual miner to think safety for his personal self, we have our feet on the first rung of the ladder of success.

The price of safety is eternal vigilance.

RENDERING SERVICE

MINE equipment worth more than a million dollars housed under one roof, is a magnificent display. At Cincinnati the manufacturers of mining equipment not only put on a magnificent show, but rendered a real service to the mining industry. Ninety-three manufacturers of all types of mining equipment united with coal mine operators in an effort to minimize operating problems through the mechanization of the mines. Operators and manufacturers after meeting in public sessions for discussion of important operating problems, went into executive session with the equipment itself. These meetings are proving themselves invaluable. Each year sees an increase in the number of exhibits that show machinery in action and each year the interest of the operator has steadily increased. There are many things that may be done to improve these expositions and conferences, and chief among them is a hall with better acoustic properties. On the whole this year's meeting was better than last year. But the main point is that the industry finds them profitable. The mechanical details will be perfected through experience. The aim of the Manufacturers Division is to so arrange and conduct these meetings as to be of genuine service to the industry and to this end suggestions for improvements are requested.

ACCIDENT PREVENTION WORK IN THE TRI-STATE ZINC AND LEAD DISTRICT

In 1924 The Tri-State Zinc and Lead Ore Producers Association Inaugurated Intensive Accident Prevention Campaign—The Results Have Been Startling And Are Attracting Wide Attention—The New York Mine Recently Won The "Sentinels Of Safety" Trophy And The Munsey Mine The District Accident Prevention Contest

By RICHARD V. AGETON*

THE Tri-State Zinc and Lead District is located in the northeastern corner of Oklahoma, the southeastern corner of Kansas and the southwestern corner of Missouri, near the junction of these three states. The mining field extends from Waco, Mo., on the north, to Miami, Okla., on the south, about 25 miles, and from Treece, Kans., on the west, to Granby, Mo., on the east, about 35 miles; however, the major portion of the production comes from a much smaller area, centering in the town of Picher, Okla.

Last year this Tri-State District produced approximately 35 percent of the world's zinc and 7 percent of the lead, with a total value of about $64,000,000 for zinc and $19,000,000 for lead or a grand total value of $83,000,000 for the metals produced. The value of the raw concentrates at the mines was nearly $60,000,000. Approximately 70 percent of this production, valued at about $43,000,000, came from northeastern Oklahoma, from an area not exceeding 15 square miles. Approximately $14,000,000 worth of ores came from the Kansas mines, and $2,500,000 from the Missouri mines. In the past few months there have been as many as 185 operating mills in the district, treating over 60,000 tons of rock or "dirt" per day, and producing in excess of 19,000 tons of 60 percent zinc concentrates and 3,000 tons of 80 percent lead concentrates per week. The majority of these mills belong to small companies, many of them controlled by local capital.

In the latter part of 1923 the Tri-State Zinc and Lead Ore Producers Association was organized by mine operators of the district, with the object of promoting the common interests of its members by compiling and recording all available data and statistics concerning production or consumption of zinc and lead ores, and disseminating such information, and other information of general interest affecting the economic conditions of zinc and lead mining in the Tri-State District. Among other duties of the Association it was decided that it was vitally and immediately important that some universal methods of Accident Prevention be inaugurated in the mines and mills of the District.

The writer was employed by the Association, of which J. F. Robinson, of Miami, Okla., is president, and J. D. Conover, secretary, in July, 1924, to assist them in conducting their accident prevention work. An invitation had already been extended to all mining operators of the Tri-State District, regardless of association membership, to cooperate in the Accident Prevention and Health and Sanitation Campaign. As a result of this invitation a considerable number of additional companies joined in the work, and all companies were asked to furnish the Association office with copies of their accident records in order that these might be compiled and studied, pending the commencement of an active and aggressive campaign against accidents.

Such a campaign was commenced in July, 1924, and has been continuous since then. From the results and experiences of similar campaigns in other mining districts and in other industries, it was determined that the work naturally divided itself into four parts: Statistics, Education, Inspection and Legislation, but that the accident prevention engineers should interest themselves mainly in the statistical, inspectional and education phases and hence this review will show our activities along these lines.

STATISTICAL PHASE

Nothing can be done toward the effective prevention of accidents nor the improvement of health and sanitary conditions, until a study has been made as to when, where and how accidents happen and of existing health and sanitary conditions. As the engineers and surgeons of the U. S. Bureau of Mines had very shortly before this time completed a survey of the health and sanitary conditions, one of the first steps by the Association was a study of accidents and the adoption of several forms for the reporting of these accident statistics to the cooperating companies. Our Accident Prevention Bulletin No. 45, is of the type used to show the causes of mine, mill and surface accidents, and the occurrence of accidents according to occupation and location of the injuries. These statistics are presented to the mining companies monthly and form the basis upon which we build our accident prevention measures. Other special statistics, such as a study of the reasons for eye accidents and the necessity of furnishing screen goggles to shovelers and machine-men; a study of haulage accidents to determine their cause and preventive measures; and a study of accident frequency according to occupation, to correctly determine the most hazardous occupations, are presented from time to time. Such data as that shown in our Bulletin No. 38 which are presented semi-annually give a comparison of the records of the cooperating companies as regards the frequency and severity of their accidents. All of these statistics are carefully

* Accident Prevention Engineer, Tri-State Zinc and Lead Ore Producers Association, Miami, Okla.

Picher, Okla., Where 30 Percent of the World's Zinc Is Produced. Note the Number and Size of the "Chat" or Tailing Piles

The Federal Munsey Mine, Winner of the District Accident Prevention Contest

studied and compared by the accident prevention engineers in their weekly meetings.

Inspectional Phase

When our organization was first outlined, in July, 1924, it was decided to get as many of the mining companies as possible to put on full-time accident prevention engineers in the 130 mills then running in the field. It was further recommended that four or five of the smaller companies, that is companies employing only 50 to 100 men, combine to employ a full-time man, or send their ground bosses and foremen to the accident prevention engineer's meetings. Believing that knowledge, enthusiasm and cooperation were all essential for the successful continuation of such a campaign, it was recommended that to promote these essentials among the engineers, the details of the accident prevention inspectional work be left to them and that they have weekly meetings to discuss their work, in order to arrive at uniform methods of procedure. These meetings were begun in August, 1924, and have been continued ever since as a part of both the inspectional and educational work of the organization.

Educational Phase

It had been proven from similar campaigns in other industries and in other mining districts, that unless a very decided effort were made to reach the community, as well as the men connected with the industry, the campaign would fall far short of obtaining maximum results. After a careful analysis of the entire situation it was decided that our educational campaign should be addressed to the people comprising the following classifications:

(a) Community (including the families of the miners).

(b) Mine management (that is to reach particularly those owners and operators who were not cooperating in the accident prevention work).

(c) The accident prevention engineers (through their weekly meetings).

(d) The mine and mill foremen.

(e) The group (the miners as a body).

(f) The individual miner.

After having consulted many authorities on the subject it was decided to base our whole campaign on the use of positive suggestive psychology to the absolute exclusion of the use of fear psychology and all commands or rules (either positive or negative) as such. With these general policies established the following methods were used, realizing that one particular method would in some instances reach more than one of the above groups, as for instance the awarding of flags for continuous operation without "Time Lost Accidents," which in the last analysis has a positive beneficial effect upon all six classifications.

Interesting the Community

The first deliberate attempt to reach the community was by the use of an accident prevention suggestion contest among school children. This contest was carried on in cooperation with the Tri-State Section of the American Zinc Institute and the American Legion. All school children were divided into two classes, those in the fifth to eighth grades, inclusive, and those in the high school, and prizes were offered in each class, both for the individual schools and for the District. All entrants were requested to send in papers containing suggestions regarding the prevention of mine accidents, these papers not to exceed 500 words. The winning papers were published in the local newspapers. The accident prevention engineers extend their thanks to the newspaper men of the District for their active and hearty cooperation throughout, and to emphasize the fact that little can be done along educational lines without such cooperation.

Concurrent with this contest among school children a series of semi-humorous articles were published, these articles all containing something regarding accident prevention work in the mines. These "chats," as they were called, were intended not only for the general public but for the miners of the District, and many of these published suggestions appeared in the suggestions submitted by the school children.

With the cooperation of the U. S. Bureau of Mines and the American Red Cross, first aid training was given to many miners in the District and also to high school children and some of the mother's clubs. This training has been given yearly and an annual "first aid contest" is held among the mine first aid teams. This contest again called the accident prevention work to the attention of both the general public and the mine workers of the field.

The U. S. Bureau of Mines also established a silicosis-tuberculosis clinic in the American Legion club rooms at Picher, Okla., to make physical examinations of miners and members of their families who desired them. The sur-

First Kangaroo Court Organized in the Tri-State District at the Lucky Bill Mine of the Federal Mining and Smelting Co.

The New York Mine, Winner of the National "Sentinels of Safety" Trophy for Underground Metal Mining

geons were assisted by welfare nurses employed jointly by the Tri-State Section of the American Zinc Institute and the Metropolitan Life Insurance Co. Over 1,000 persons were examined in 1925, and all of them were given instruction regarding the prevention of tuberculosis by sanitation and proper feeding, and the prevention of silicosis by proper hygiene, sanitation and the keeping down and the prevention of the formation of siliceous dusts in the mine.

Recently an accident prevention limerick contest was held in which a prize was offered to the person submitting the best missing line for the limerick. Each of these limericks were designed to cover some phase of accident prevention or health and sanitation work and the response was very pleasing, both from the number of answers submitted and from the useful ideas brought to light by them.

Interesting the Management

The main appeal used in interesting the management of those companies not cooperating in accident prevention work was the publication of some of the accident prevention statistics and bulletins in the newspapers of the District. Some of these bulletins had a community as well as a managerial appeal. In addition to these, individual accident statistics were sent to the managers of those smaller cooperating companies which could not afford to hire accident prevention engineers, in order that they might be better informed, not only as to the trend of accidents in the District but as to the results of accidents in their own mines.

Interesting the Accident Prevention Engineer

The best method of accident prevention engineer education was their weekly Wednesday morning meeting. At these meetings each accident prevention engineer reported first, the total number of accidents occurring at those mines in which he was employed, second, the total number of man-shifts worked in the mines during the preceding week, and third, the accident frequency, that is the number of accidents per thousand man-shifts for the preceding week. Each engineer was thus enabled quickly to estimate his standing as compared with the group standing. From the discussion which followed of the best practices noted during the preceding week, each was also able to determine the preventive measures to be emphasized by him during the coming week. After this discussion a discussion was held of a few of the more peculiar accidents which had occurred during the preceding week and remedial measures were suggested.

Many of these men prepared short articles for publication on such topics as, "The Foreman's Responsibility in Accident Prevention," "Labor Turnover and Accidents," "Leadership and Its Application to Accident Prevention," and other similar subjects. These papers had some general appeal, as well as a direct appeal to all men in the mines.

Recently Mr. I. R. Anderson of the Federal Board of Vocational Education, acting in conjunction with the State Boards of Kansas, Oklahoma and Missouri and the Oklahoma State School of Mines, commenced a conference of the accident prevention engineers. This conference has just passed the job analysis stage, but already many good results are noticeable.

Interesting the Mine and Mill Foremen

The first deliberate attempt to reach the mine or mill foreman was through the use of a Suggestion Contest. All mine and mill foremen in the Tri-State District were invited to send in a list of the 10 suggestions which in their opinion would effect the greatest reduction in mine and mill accidents. No individual suggestion was to exceed 10 words in length. At the time of the contest there were approximately 150 mills running and we received 67 lists. A great deal of publicity was given to the winning lists, and consequently there was some community interest aroused as well as that of mine and mill foremen.

Later, prizes were awarded to the mine and mill foremen working the greatest number of consecutive man-shifts without a "Lost Time" accident. This contest also received a good deal of favorable publicity, so much so in fact that shortly after the first attempt several flags were designed in recognition of meritorious accident prevention work in the mines. A flag was given to every mine working for two months, four months or six months without a "Lost Time" accident, and these were known in order as the "Pete Flag," "Star Flag," and "New Broom Flag." A silver loving cup was added to these prizes and it was offered to the mine having the greatest number of consecutive man-shifts without a "Lost Time" accident. At the present time two mines have worked for more than nine months, or more than 18,000 continuous man-shifts, without a "Lost Time" accident. Many of the mining companies pay their foremen a bonus of from $5.00 to $25.00 a

The Ore Producers' Office and the District's Safety Engineers

month for each month's work without a "Lost Time" accident.

Many of our statistical bulletins and all of the reports of the Accident Prevention Engineer's meetings were published, as well as the series of articles on the foreman's place in industry and his duty as regards accident prevention work. Last December foremanship training classes were organized with the cooperation of the Oklahoma State School of Mines and the Boards of Vocational Education in the States of Oklahoma, Kansas and Missouri. Approximately 100 foremen have attended these conferences in groups of from 10 to 20 men. This work has been so beneficial from all angles that it will be continued until practically all of the foremen have received the training.

Interesting the Group and the Individual Miner

All of the methods described under the preceding classifications, particularly the contests, the flags and the general newspaper publicity, was of interest to the individual miner, and thus the group of workers.

For their particular benefit however, shortly after the suggestion contest among mine and mill foremen, there was a similar contest inaugurated for miners and mill men with the same rules. This contest was also given favorable publicity and aroused considerable community interest.

Many powder manufacturers, accident prevention engineers and machinery salesmen have given talks to the miners during the lunch hour at mines where a "Kangaroo Court" has been organized. While our organization did not originate the "Kangaroo Court" idea, we have found it such a valuable adjunct to our campaign that we have assisted in their organization until we now have about 30 of them functioning.

An Accident Prevention Calendar was designed for distribution to the men in the employ of the mining companies. "Accident Prevention Pete," whom we have adopted as our trade mark, appears on each sheet of the calendar as well as on other literature.

A specially designed and labeled cigar was given to each man in every mine winning any of our flags or a "Fete Button" or a bust statuette of "Pete."

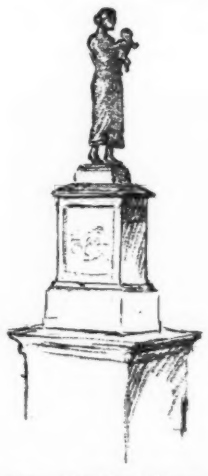
A series of night classes on accident prevention work were held during November and December, but it was decided to postpone these meetings until after the completion of the foremanship training classes in order that the foremen might assist at the meetings.

A series of posters covering the best local practices were developed and distributed, not only in poster form but also in the Tri-State Weekly, a local mining paper. These posters are issued semi-monthly and show the best practices in use, such as the wearing of steel helmets by hookers and bumpers, the wearing of screen goggles by shovelers, brunomen and machinemen and other similar ones.

General

Our whole campaign has been based upon the use of positive suggestive psychology and also upon the hypothesis that in order for the campaign to be of lasting benefit it should be presented to the community as well as to the men directly engaged in the mining industry. All of the appeals were made, first, to contain a recognition of the intelligence of the working man; second, they were made in person whenever possible, by the immediate foreman, the accident prevention engineer or by a personal letter from the management whenever an opportunity presented itself for a congratulatory letter; third, all of the bulletins showed the correct methods of doing things so that all men would be able to imitate them with safety—care being taken to make the titles plain but not in the form of commands; fourth, all posters, movies and bulletins were designed to take advantage of the psychological quirks peculiar to this branch of the industry with which we are dealing, and also to make full use of color and form psychology; fifth, extreme care was taken to see that all of us connected with the work maintained a spirit of cooperation and fair dealing, even when it became necessary to punish offenders; sixth, "Accident Prevention Pete" was adopted as our trade mark and "Pete" always carried a suggestion of the Accident Prevention Campaign in its entirety to anyone seeing his likeness.

That our campaign has been effective is evidenced by the fact that many of the mines have worked from seven to fifteen thousand consecutive man-shifts without a "Lost Time" accident. The average production of 30 of the companies actively engaged in the accident prevention work was more than 1,700 rock tons per accident, with one company producing as high as 5,000 tons per accident; in these records all accidents, including minor ones, are included. Several individual companies have effected very pronounced reductions in their accident costs, and it has been estimated that the saving last year amounted to approximately one-fourth of the cost of accidents for the preceding year.



The Safety Trophy Given by the Explosives Engineer

IGNITION OF GAS BY HEATED SURFACES

An investigation of the ignition of natural gas by heated surfaces is being conducted by the Bureau of Mines. The object is to study the probable source of natural gas ignition in coal mines caused by heated surfaces, which may be due to friction or other causes. Especial attention will be paid to the following possible causes: Overheated conductors, sparks from cutter bars of electric coal-cutting machines, friction of rotating parts, such as wheels and brakes of locomotives, and by roof falls.

One hundred members of the Mine Inspectors' Institute of America, assembled in annual convention in Pittsburgh, Pa., May 11 to 13, were guests at a dinner held on Tuesday evening, May 11 at the factory of the Mine Safety Appliances Co., Braddock Avenue and Thomas Boulevard, in that city.

Following the close of the afternoon session on the opening day of the institute, the members were escorted in taxicabs from headquarters in the Seventh Avenue Hotel to the plant of the Mine Safety Appliances Co., where officials of the company conducted the party on an inspection tour of the factory. During the course of the dinner, which was served at 6.30 p. m., the guests were entertained by a local theatrical troupe and orchestra.

The guests were welcomed by George H. Deike, president of the Mine Safety Appliances Co., and the response was made by Frank Hillman, of Mulga, Ala., president of the Institute. Following the dinner, the members of the Institute were taken by machines to the convention headquarters.

The Anaconda Copper Mining Co., at its own mill at Great Falls, and at the plants of its subsidiary, the American Brass Co., turned out in 1925, 790,000,000 pounds of fabricated copper and brass products, or approximately 25 percent of the world's production of copper for 1925.

The production in 1925 compares with 627,680,895 pounds in 1924, an increase of 162,300 pounds, or almost 26 percent.

SAFETY TROPHY AWARDS

Trophies Awarded Winners In National Safety Competition Which Was Participated In By Approximately Three Hundred Mines And Quarries

EXTRAORDINARY records of large industrial production with no loss of time occasioned by accidents were revealed in connection with the announcement of the names of mines and quarries adjudged winners of the national safety competition held under the auspices of the Bureau of Mines, for the bronze trophy "Sentinels of Safety," donated by the Explosives Engineer magazine. A Maryland quarry operated 350 days and worked 202,663 man-hours during 1925 with no loss of time from accident. Four other quarries, located in Indiana, Tennessee, New York, and California, also operated with no loss of time due to personal injuries.

Nearly 300 of the larger mines and quarries participated in the competition, the contestants being divided into five groups: Anthracite mines, bituminous coal mines, metal mines, mines producing nonmetallic minerals, and quarries or open-pit mines. A replica of the trophy is awarded to the mining operation in each group sustaining the smallest loss of time from accidents in proportion to total time worked during the year. Determination of the winners was made by a jury of award comprised of officials of various mining and quarrying associations, the National Safety Council, and the American Federation of Labor, based on a tabulation of mine-accident data prepared by the Bureau of Mines. A feature of the competition is the awarding of a certificate of honor, signed by the Director of the Bureau of Mines, to every employe of each of the winning mines and quarries for their share in the low accident records made by their companies.

The winner in the anthracite group is the Upper Lehigh mine, Upper Lehigh, Pa., operated by the Hazel Brook Coal Co. In this group honorable mention was accorded the Midvalley mine, Wilburton, Pa., operated by the same company.

The winner in the bituminous coal mining group is No. 6 mine of the United States Coal & Coke Co., at Gary, W. Va. Honorable mention was given the No. 3 mine of the same company, also located at Gary; and the Rossiter Nos. 4 and 5 mines, at Rossiter, Pa., operated by the Clearfield Bituminous Coal Corporation.

In the underground metal mining group the New York zinc and lead mine of the New York Mining Co., of Picher, Okla., was adjudged the winner. Honorable mention was accorded the Beaver lead and zinc mine of the Commerce Mining & Royalty Co., at Carden, Okla.; the Velton zinc ore mine of the Eagle-Picher Lead Co., Bricefield, Mo.; the lead mine of the St. Louis smelting and refining works of the National Lead Co., at St. Francois, Mo.; and the Goodwin lead and zinc mine of the Eagle-Picher Lead Co., at Picher, Okla.

In the group of underground mines producing nonmetallic minerals the trophy was awarded to the Lower gypsum mine of the United States Gypsum Co., at Gypsum, Ohio. Honorable mention was accorded the Ironton underground limestone quarry, operated by the Alpha Portland Cement Co., Ironton, Ohio; the Crystal City sand mine of the Pittsburgh Plate Glass Co., at Crystal City, Mo.; the limestone underground quarry of the Alpha Portland Cement Co., at Milltown, Ind.; and the Bell underground high calcium limestone quarry of the American Lime & Stone Co., at Bellefonte, Pa.

In the quarry and open-pit mine group the winner is the Security quarry of the North American Cement Corporation, at Security, Md. Honorable mention was accorded the cement rock quarry of the Louisville Cement Co., at Speed, Ind.; the limestone quarry of the Dixie Portland Cement Co., at Richard City, Tenn.; the Cementon quarry of the Alpha Portland Cement Co., at Cementon, N. Y.; and the andesite quarry operated by the City of Los Angeles Harbor Department on Catalina Island, Calif.

Companies operating a coal mine employing 50 or more men underground, a metal or other mine employing 50 or more men underground, or a quarry or open-pit mine employing 25 or more men in the pit were eligible to compete for the trophies. The trophy, which is the work of Begni del Piatta, designer of the Navy and Marine Memorial to be erected in Washington, portrays in bronze a mother and child greeting the father upon his safe return from work. The names of the mines and quarries who win the right to hold the trophy for a year will be engraved on the pedestal. On the remaining sides of the pedestal are panels emblematic of coal mining, metal mining, and quarrying and open-pit mining. The trophies will be bestowed upon the winning companies at the International First-Aid Meet, to be given under the auspices of the Bureau of Mines at San Francisco, Calif., early in September.

Members of the jury of award were as follows: H. Foster Bain, secretary, American Institute of Mining and Metallurgical Engineers, New York; James F. Callbreath, secretary, American Mining Congress, Washington, D. C.; W. H. Cameron, managing director, National Safety Council, Chicago, Ill.; H. L. Gandy, secretary, National Coal Association, Washington, D. C.; A. T. Goldbeck, director, engineering bureau, National Crushed Stone Association, Washington, D. C.; William Green, president, American Federation of Labor, Washington, D. C.; H. G. Jacobsen, manager, bureau of accident prevention and insurance, Portland Cement Association, Chicago.

SAFETY RULES FOR METAL MINES

THE Industrial Commission of Utah has just issued a "Safety First" pamphlet on "Safety Rules for the Protection of Metal Miners." The commission in releasing the booklet has the following to say:

"This booklet is intended to serve as an opening wedge or an introductory appeal in the interest of the employe, the employer, and the public, the commission having thought for some time that men directly engaged in this industry could be successfully appealed to.

"Accidents not only cause suffering and loss of time to the injured but the result in privation and want to dependents; they create confusion among and lessen the efficiency of employes where they occur; they slow up production; they increase compensation costs; they cast upon society annually thousands of industrial wrecks who become objects of charity; they add to the burden of the taxpayer; they contribute to the high cost of living; they change providers into seekers of alms; they rob children of the necessities of life and blight their chances for an education; they cast up an annual crop of widows and orphans and impair the national strength by decreasing its man power.

"In this country not less than 1,000,000 accidents occur in industry each year at a cost of more than a billion dollars. It is conservatively estimated that one-half of this money and human wastage is the direct result of the workmen's own carelessness. Something should be done to stop the accident habit."

The American metal market has announced a new issue of METAL STATISTICS, the 19th annual edition.

METAL STATISTICS, 1926, is larger than any of the preceding issues and contains a complete record of statistics on practically every phase of the iron, steel and metal industries.

The usual tables of production, consumption, imports, exports, stocks, prices, averages, etc., have been actively revised and include the latest available data for 1925. In addition, many new tables have been added, not only on iron, steel and metals and their allied products, but also on subjects of general interest.

SAFETY AND WELFARE AT THE HOMESTAKE

This Company Employs A Full-Time Safety Engineer, With An Assistant, Who Teaches Classes In Mine Rescue And First Aid And Looks After Underground Fire Prevention—Two Safety Committees Cooperate With The Safety Engineer—Results Obtained Highly Satisfactory

By CHAS. A. BROOKS *

Photographs by Lease

IN order to tell you of the safety work at Homestake, it will be necessary to tell of some of the other things we do besides getting the ore out of the ground.

The company employs about 1,800 men of which 750 are working for the mining department.

The gold mine is at Lead, S. Dak.; the tungsten mine at Lead; the mills, cyanides, and slime plant are at Lead, Terraville and Deadwood; the machine shops and foundry at Lead; the limekiln at Calcite, S. Dak.; the electric water power plants at Englewood, Maurice and Spearfish, S. Dak.; the steam electric at Lead; and the saw mills at Nemo, S. Dak., and Moskie, Wyo. So you see, safety must cover quite a few different operations, and is somewhat spread out.

The company employs a full time safety engineer, and he has an assistant, who teaches classes in mine rescue and first aid and looks after the underground fire prevention. Fire prevention on the surface is under the direction of a fire marshal.

SAFETY COMMITTEES

Working with the safety engineer are two safety committees, the Central Safety Committee and the Workmen's Safety Committee.

The Central Safety Committee is composed of the general manager, who is chairman; assistant general manager, superintendent of the mine, head of the legal department, employment agent, chief metallurgist, master mechanic, chief surgeon, chief electrician, head carpenter, superintendent of timber supply, and the safety engineer, who is secretary of the committee. This committee meets every month and decides on matters brought up at the workmen's meeting and any other thing that will promote safety.

The Workmen's Safety Committee is made up of one man from each of the surface departments, metallurgical, carpenter, electrical, timber, and mechanical, and nine men from the mine. The members of this committee are elected by secret ballot by their fellow workmen and serve for one year. Half of the committee serve from January to January, and the rest from July to July. These men make an all day inspection trip before their meeting. The surface committee visits the different departments on the surface and the mine men visit levels other than the ones on which they are working. This committee meets every other month with the Central Committee. They report conditions, discuss accidents and their prevention, and are at liberty to bring up any subject they see fit for their own or fellow workmen's safety or welfare.

All safety meetings are open to the public and all are welcome.

The state inspector of mines is always invited to these meetings and he generally attends.

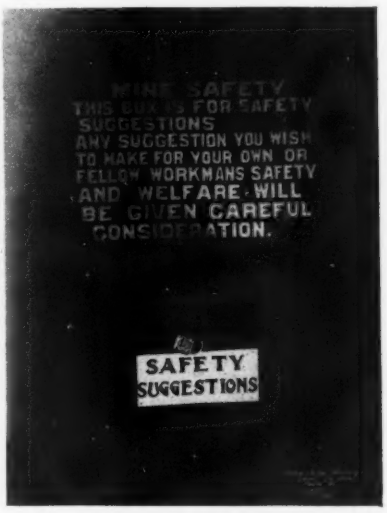
FIRST AID

We have a regular first aid instructor who also gives instructions in mine rescue.

The United States Bureau of Mines men give instructions once a year. We train new men and give a review to "Certificate" men every six months.

In the mine we pay particular attention to the training of shift bosses, trackmen, motormen, timbermen, and pipemen, because in case of an accident it is easy to locate them and have them render assistance.

The first aid instructor gives demonstrations before special classes in the public schools, and also assists in the instruction of Boy Scouts, Girl Scouts and Boy Rangers in first aid and safety. These classes are held in the regular company first aid room on Saturdays or after school.



Safety Suggestion Boxes

First aid kits are kept in convenient places in all departments.

In the electrical department every man must actually perform artificial respiration for at least 20 minutes once every month. This practice is under the direction of the regular first aid instructor, and takes place on the first Tuesday (after the first Monday) of every month.

New men are instructed by the men they work with until they have a chance to attend the regular monthly instruction period.

The first aid instructor generally has a story or two to tell of actual cases where a knowledge of the prone pressure system of artificial resuscitation saved a life.

That these meetings keep up in the interest in safety is evident when we consider that the men in the electrical department worked 110,955 hours without a lost time injury that could be charged to the hazard of their work. They had only one accident, where a linesman helper sprained his ankle and was off six days.

MINE RESCUE

We have 12 sets of self contained oxygen breathing apparatus and everything that goes with them to make an up-to-date mine rescue station.

The station is composed of two large rooms, one for storage and work bench, the other for instructions and assembly of the apparatus.

We have an underground smoke room on the tramway level and have it equipped with enough material to keep the men busy for their two hour practice period.

All Bureau of Mines "Certificate" men are given additional training every six months.

From the mine we have enough men trained to take care of any emergency.

A certain number of surface men, such as electricians, blacksmiths, machinists, welders, and carpenters are also trained in mine rescue.

STATISTICS

We keep a record of every injury and make a report to the state inspector of mines, whose office is in Lead, the United States Bureau of Mines, and to the Commissioner of the South Dakota Workmen's Compensation Board.

Every serious injury is reported to the state mine inspector, who visits the place where the injury occurred, and a sketch is made or a picture taken of the place, for the information of the general man-

* Safety Engineer, Homestake Mining Co.

Ellison Station 1400, *Showing Finger Gate and Ore Bin Over Crusher*

Ore Chute. Double Chutes Used Under "Draw Holes"

ager and the head of the department where the accident occurred.

We figure accident *frequency* in terms of the number of *lost time injuries* per million hours worked, and accident *severity* on the basis of *days lost* per 1,000 hours worked.

Monthly reports are made to the general manager, and to the safety committees on the usual run of statistics, such as tabulated frequency and severity comparisons of different departments, and in the mine of different divisions of the mine and different levels, causes of injuries, part of the body injured, occupation of man injured, age of injured person, length of experience, etc.

Bonus System

To the Men:

The company gives a bonus of $10 annually to every man working *in the mine*, who has worked 300 or more shifts without a lost time injury during the year. (*A lost time injury* is one in which more than the balance of the shift during which the injury is sustained, is lost.) For 1925, 273 men received this bonus.

To the Shift Bosses:

Five dollars per month to underground shift bosses who have 300 or more shifts worked under them, and who have had no lost time injuries under them.

Twenty dollars every six months to each underground shift boss having 500 or more shifts under him per month (or $10 if he has had less than 500 shifts but more than 300 shifts per month) if *frequency* rate for the *half year* is less than 62.5 lost time injuries per 1,000,000 hours worked.

Twenty dollars annually for *frequency* awarded same as per the preceding paragraph.

Twenty dollars *annually* to each underground shift boss if the *severity* rate of his gang for the year is less than 0.5 days per 1,000 hours worked.

To the Mine Foremen:

Award each mine foreman an amount equivalent to 25 percent of the bonuses earned by the shift bosses under him.

Mine foremen are also eligible for the shift boss awards listed above, if they have had enough shifts worked under their personal supervision.

To the Night Foreman:

An amount equivalent to 15 percent of bonuses earned by all shift bosses.

To the Assistant Night Foreman:

An amount equivalent to 10 percent of bonuses earned by all shift bosses.

Visiting Days

(*The best safety stunt we have*)

The underground mine is divided into three sections, each under the direction of a day foreman, who, in turn, has from 5 to 10 shift bosses under him. Each of these three men is responsible for everything in his territory.

Manway and Air Raise

Every Thursday afternoon two of the foremen visit the territory of the third in order to acquire a thorough knowledge of the whole mine and to pick up useful safety and operating ideas. As the foreman has no idea what part of his territory his guests will desire to inspect, he must have it all ready for a stiffer inspection than was ever "pulled off" in the army. As competition is very keen, no foreman is willing to have his fellow foremen find his territory in any but first-class condition.

The same idea is used with the shift bosses, who make their trip on the afternoon of the "change" Sunday (winter only). As only the mine superintendent knows to what part of the mine these men will be sent to inspect, it is up to every shift boss to keep his level in the best of condition. These trips give the bosses many useful and practical ideas, give them an opportunity to learn about the whole mine, and stimulate them to keep their territories in first-class shape in order to avoid slams sent in their direction by fellow bosses.

Physical Examination

Everyone starting to work for the company must pass a physical examination.

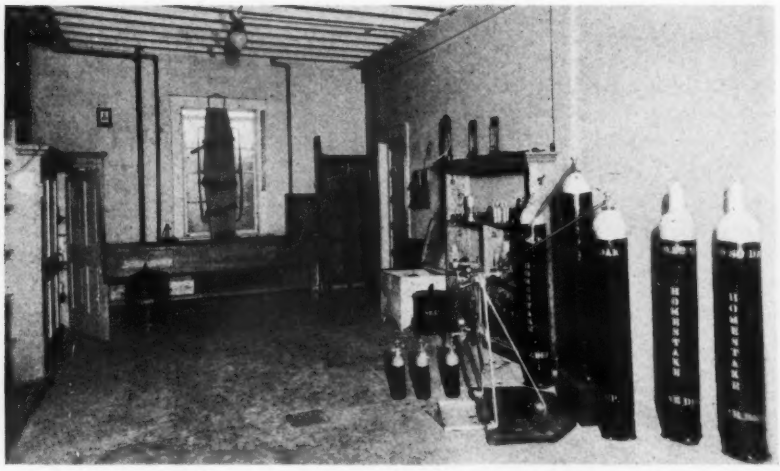
Anyone can have an examination at any time he wants one, but it is not compulsory.

Hoisting engineers are examined once a year, and some men who have had three or four injuries during the year are examined for poor vision.

All men are hired by the employment manager.

Hospital

The Homestake Mining Company maintains a first-class hospital at Lead and an emergency hospital at the sawmills at Nemo. The Nemo Hospital has



Mine Rescue Room. Storage and Work Bench

one physician, who looks after all the men working at Nemo and all men working in the woods.

The Lead Hospital has five physicians and the necessary number of nurses. All services are free to the employe and his family. This includes the filling of prescriptions.

An ambulance with a competent driver is always in readiness to answer any sick or injury call.

The company insists that every man injured, however slightly, must report to the hospital. The ambulance takes the injured man from his department to the hospital, and if he is able to go back to the work, he is taken back to his department. If not severely injured, he is taken to his home.

The ambulance is also used for sick calls for employes or their families.

Bulletin Boards

Each department has its bulletin board. As no posters are allowed underground, those for the miners are so placed that the men can see them while standing in line for carbide and oil. Most of the posters are furnished by the National Safety Council.

Home-made slides, mostly slogans, are run at the picture show.

Once a year we have a safety meeting for the people of the city. At these meetings we have speakers of local and national importance.

The company maintain "safety suggestion boxes" in which written suggestions can be placed. These suggestions are given careful consideration by the Central Safety Committee.

Employes' Aid Fund

We have an employes' aid fund which takes care of sickness and accidents not covered by the South Dakota workmen's compensation laws.

All employes contribute $1.50 per month; the company furnishes without charge such office room, stationery, and clerical help as is necessary to administer the fund.

Members disabled by sickness or accident not covered by the South Dakota compensation laws receive from the aid fund $1 per day, to commence after the sixth day lost by sickness or such accident, and to cover a period not to exceed three months from date of disability. If at the expiration of this time the member is still disabled, the rate of payment increases to $1.50 a day, and continues at this rate for a period not to exceed nine months from date of disability. The board of directors, however, may at discretion consider disabilities due to sickness which continue beyond the time limits stated above.

In addition to the benefits stated above, there is a death benefit of $800.

Men are pensioned by the company on account of old age, sickness, or any disability that prevents them from working. This amounts to $50 per month.

The "Homestake Veterans" is an association of men who have worked for the company for more than 21 years. There are at the present time about 170 members; most of them are still in active service.

They have their own social meetings and always take an active part in community affairs.

The Homestake Aid Auxiliary, the women's auxiliary to the employes' aid fund, looks after people who are temporarily in need of help. They furnish food, clothing, wood, and coal to needy families. The company furnishes some coal and wood free of charge, which is distributed at the discretion of the ladies. The organization secured funds sufficient to last a year by having a Labor Day picnic. Everything for this is donated by citizens.

Fiftieth Birthday

This year is the fiftieth birthday of the Homestake Mining Company. The Homestake Veterans and the ladies of the Homestake Aid Auxiliary will celebrate for two days, August 6 and 7.

One whole gulch is being fixed up for them for old-time mining scenes—placer mining, with pans, sluice boxes, rockers, long Toms, and hydraulicking. The first stamp mill brought to the Black Hills will be set up. A dozen log cabins are being built, the first boarding house and hospital ever built in Lead will be reproduced, and, of course, a few of the many old-time saloons, dance halls, and stores will be in evidence. All old timers will take part. There will be real Indians, holdup men, stage coaches, bull teams pulling covered wagons, prospectors, burros under full pack, trappers and traders, and all the old famous characters of the Hills, such as Preacher Smith, Wild Bill, Lame Johnny, Calamity Jane, Scissors, Pop Corn Jennie, Faro Bill, Lottie Carl, French Curley, Doc Pierce (the original will be there himself), San Juan Joe, Fly-Speck Billie, Chief Sitting Bull, Sorrel Horse, Father Desmet, the Manuel Brothers, and Captain Bullock, the first sheriff of Lawrence County.

The first day there will be a parade of old-time transportation methods, burros and pack horses, covered wagons drawn by yoked bull teams, stage coaches, prairie schooners drawn by six and eight horses, Indians with their Dakotan travails, and men on foot.

The second day there will be another parade of modern means of travel.

The celebration will end up with the greatest pageant ever presented in the Black Hills, 500 taking part. It will depict the history of the Black Hills from before the coming of the first white man to the present time.

It will be a real home-coming week, as old timers from all over the United States have informed the committee that they will be here.

Recreation Building, Theater, and Library

The Homestake Recreation Building was built in 1914. It has a large lounging room, billiard and pool rooms, rooms for children's table games, and athletic room, tables for cards, chess, and checkers, six bowling alleys, an indoor shooting gallery, which is used by the local rifle club for winter shooting, and a plunge 25 feet by 75 feet with a lady attendant. There are also rooms that are used by local lodges and clubs for committee meetings. The Homestake Band uses the athletic room for their practices.

The theater is in the same building. It is up to date in every respect—individual dressing rooms, with hot and cold water, a (*Continued on page* 456)

BRINGING SAFETY TO THE MINER

Provisions Making For Safety In Mining Outlined. Safety Measures Are From Two Sources —Legal Requirements And Voluntary Action. Workmen's Compensation Laws And Inspections By And Rate Provisions Of Insurance Companies Stimulus To Safety And Welfare Work

By R. R. SAYERS* and J. J. FORBES†

BRINGING safety to the miner may be divided for discussion into methods required by law and those carried out voluntarily. The first includes the enactment and enforcement of laws and regulations requiring (1) that safe and sanitary working conditions be provided; (2) that safety of workmen be made the first consideration; (3) that the protection of health and the practice of safety be a condition of employment of all officials and employees; (4) that safe direction of all workmen be required of company officials; and (5) that safety organizations, composed of all officials and representatives of the employees, be established. The second consists in (1) supplementing the mine organizations with a community safety activity, to include all mine employees and their families, for the purpose of cooperating in the promotion of health and safety in the community; and (2) advertising safety by the use of bulletin boards, lectures, motion pictures, demonstrations, first-aid contests, athletic events, posters, and records of unsafe practices of officials and workmen.

State mining laws have been enacted for the safety of the worker, and frequent inspections are made by state mine inspectors looking to the enforcement of these laws. In a great many instances such laws have been supplemented by safety rules and regulations of individual companies, which maintain their own committees and inspectors, who make frequent examinations and recommend methods of protection for the workers. A great stimulus to the enforcement of state mining laws and company regulations has been the enactment of workmen's compensation laws; also insurance companies, operating under these laws, usually provide inspectors who make frequent visits to the mines and recommend safety measures to the operating companies. Some insurance companies have

a minimum rate for an ideally safe mine and make additional charges where certain precautions are not carried out. These charges above the base rate are assessed per $100 pay roll, for example, as follows:

	Cents
For a mine not having first aid	22
For a mine not having a receiving station	8
For a mine not having underground supplies	5
For a mine not having at least 1 man in 20, or 5 percent of all underground employes, trained in first aid	9
For a mine not having mine-rescue facilities and not having at least 1 man in 50, or 2 percent of the men, trained in rescue work	4
For a mine not having apparatus, either at own station or central rescue station	5
For a gassy mine not having approved safety lamps	15
For a mine not rockdusted	5
If a mine is rockdusted, in addition to the additional charge of 5 cents not being assessed, a credit of 10 cents is also given.	

All these agencies contribute their part in bringing safety to the worker.

Many methods and appliances might be enumerated that have contributed in one way or another to bring about safe and sanitary conditions in mines, but it is safe to say that one of the most important of these is the providing of good and adequate ventilation to dilute and render harmless any noxious gases and to carry away dust which may be hazardous to the miner. The hazard from the explosion of dust in coal and metal mines has been very materially reduced by allaying the dust at its source. In coal-mining operations the application of water to the cutter bar of mining machines has practically eliminated the health hazard and at the same time minimized the explosion hazard. In metal-mining operations this problem is being solved with marked success by the substitution of wet drilling for dry drilling. In addition to wet methods at the face of workings, dust is being allayed by the use of water at other places in the mines. The coal-dust explosion hazard, heretofore a potential danger, has been eliminated in certain mines by the widespread use of rock-dust.

A great deal of work has been done to encourage the mining industry to provide safe working equipment by the United States Bureau of Mines testing such equipment to determine its safety. Mining equipment that passes these tests or schedules is placed on the "permissible" list. The dangers that existed heretofore through the use of unapproved equipment have been practically eliminated in many mines by the substitution of "permissible" equipment. "Permissible" electric cap lamps are rapidly replacing open lights; "permissible" explosives are replacing the use of long flame black powder; "permissible" mining equipment is supplanting the use of all open type mining machines in a number of instances, thereby eliminating possible sparks with the consequent danger of ignition of gas. Such equipment has undoubtedly been the means of reducing the loss of life considerably. All of these appliances

* Acting Chief Engineer, Safety Service, Bureau of Mines, Department of Commerce.
† Chief Engineer, Safety Extension Service, Bureau of Mines, Department of Commerce.

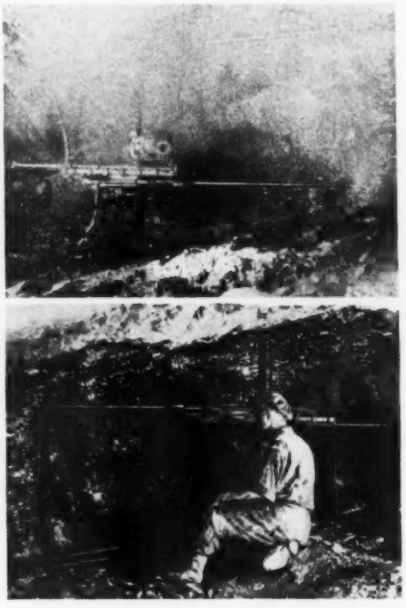
have been brought to the miner for his protection and safety.

Mechanical safeguards, where properly installed, have been the means of very materially reducing fatalities and injuries in mining operations. No attempt will be made to give in detail all of these safeguards, but mention should be made of at least the more important ones, as those for electric wires, either throughout the mine or at places where men pass under them, and those for electrical machinery. Guards over openings and safety catches on skips and cages, and the protection of the eyes of the miners by goggles, together with many other devices and appliances, have contributed their part to greater mine safety. Maintenance of proper clearance along haulageways, the use of manholes or shelter holes, clean and unobstructed roadways, and numerous other similar practices contribute in no small degree to the safety of the miner. Sanitary conditions have been materially improved at a large number of mines by the maintenance of wash and change houses.

The success of any movement for the promotion of health and safety depends to a large extent on the careful direction of the workmen by the company officials in charge of the operation. The employing company should make the practice of safety a consideration in the employment of all officials and employes. Officials in charge of the operation must recognize their responsibilities. They are the official representatives of the employer, and, as such, it becomes their duty to direct each class of workmen employed at an operation in a manner that will assure the maximum of safety as well as efficiency. The foreman charged with the placing of new workmen or the assigning of other workmen to duties to which they are unaccustomed should inform them in regard to the hazards to be encountered and instruct them how to avoid them. He should make visits frequently to ascertain whether they are carrying out his instructions. Under no circumstances should unexperienced workmen be given employment unless they are placed along with an experienced worker, whose duty it should be to see that they do their work safely.

The activities outlined in the foregoing paragraphs can be accomplished successfully through the formation of a plant or mine safety organization, composed of all officials and representatives of the different classes of employes. Meetings should be held at least once each month, and reports of the health and safety work submitted and reviewed and action taken to prevent recurrence of any fatalities and injuries that may have taken place and remedies decided upon for all existing hazards reported. This organization, if efficiently conducted, will insure joint cooperative effort on the part of all officials and employes in the promotion of health and safety.

The forms of safety work carried out voluntarily are so numerous that reference will be made only to those regarded as the most important. The most practical and successful method thus far employed is the establishing of a safety organization to enlist the cooperation of all



Photographs Showing the Obvious Difference Between Dry and Wet Drilling

company officials and employes and their families to supplement the work of the plant or mine safety organization for the promotion of health and safety in the mining communities. Chapters of the Holmes Safety Association embody all the activities in which such an organization could engage. In brief, the Holmes Safety Association is a memorial association established at the request of all the outstanding mining organizations in the United States to perpetuate the life work of Dr. Joseph Austin Holmes, first Director of the Bureau of Mines, and foremost advocate of safety in mining. Its field of activity embraces organized cooperative effort looking to:

1. The prevention of fatalities and injuries, and the improvement of health conditions of all persons connected with the mining, metallurgical, petroleum, quarrying, and allied industries at work, in the homes, and in public places, and to promote the general welfare of its members.

2. The dissemination of information and instruction on all subjects relating to the promotion of health, safety and efficiency, and the prevention of mine fires, mine explosions, and disasters.

3. The promotion of training in first aid, the wearing of oxygen breathing apparatus, and other protective devices, and in mine rescue and recovery operations.

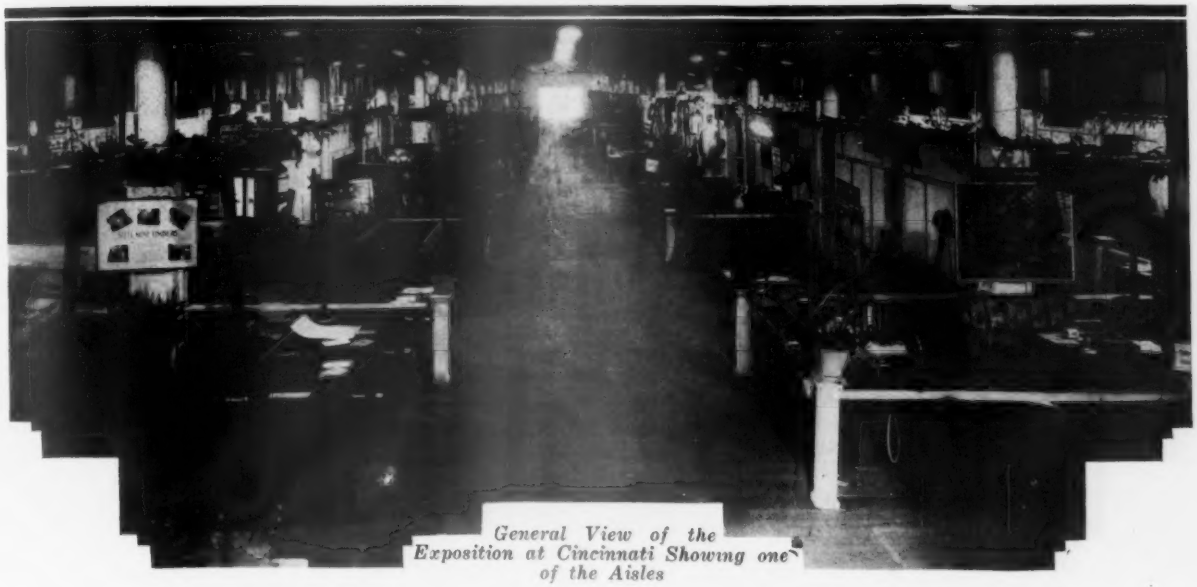
4. The closest cooperative relations with all existing organizations, including local, state, and Federal agencies, having for their purpose the promotion of health, safety, and efficiency.

5. The promotion of educational, social, and recreational activities, including cooperation with local, state, and Federal school authorities, and other institutions in the training of plant employes and the advancement of education.

The plan of organization includes local chapters in mining communities, district councils to assist those chapters in their work, state councils to assist the district councils and local chapters, and finally the coordination of all the activities through a national body called the national council of the Holmes Safety Association. The president of the national association, by the provisions of the constitution, is the Director of the Bureau of Mines. To date 168 of these chapters, together with a number of district and state councils, have been established throughout the United States. The results obtained thus far indicate that the Holmes Safety Association will spread rapidly to all mining, metallurgical, petroleum, quarrying, and allied industries, and become the outstanding national organization for the promotion of health and safety in these industries. If all persons interested in the advancement of the safety movement in the industries named would investigate the advantages to be obtained from the Holmes Safety Association, they would find that its activities merit their support and fill a long felt need.

As other methods of promoting safety educational work, mention should be made of the value of bulletin board service, motion pictures, demonstrations, accident prevention campaigns, first-aid contests, and the use of posters and the frequent distribution of official circulars, containing information on accidents and their prevention. All of these methods and many others are being employed to a considerable extent and have been productive of much good in conveying the message of safety to the miner. The posting at each man's working place of placards which give a detailed record of unsafe practices and violations has been used with marked success. An official inspects the working places, notes any unsafe conditions, writes them on the placard, and affixes his signature. No man wants to see his name on this placard. This scheme is a check not only on the worker but also on the official making the inspection. This system has been productive of large reductions in the number of accidents at the mines in which it is in operation.

The plans and methods proposed, if efficiently carried out, should prove to be valuable means for the preservation of human life and property.



General View of the Exposition at Cincinnati Showing one of the Aisles

PRACTICAL COAL MEN MEET AT CINCINNATI

Practical Coal Operating Men In Session At Cincinnati Show Great Interest In Mechanization Of The Mines—Exhibit Of Mine Equipment Great Adjunct To Discussions—Attendance Was Large And Representative—Both Convention And Exposition Unqualified Successes

THE Convention of Practical Coal Operating Officials, and the National Exposition of Coal Mine Equipment, held at Cincinnati, Ohio, during the week of May 24, was an unqualified success from every standpoint. The program was excellent and carried the sustained interest of operating men from start to finish. The exhibit was the finest yet staged. The number of operating exhibits was greater than at previous expositons. In the tent at the rear of Music Hall mechanical loading was demonstrated by the Coloder, Myers-Whaley, Joy and Jeffrey loaders. The Jeffrey Manufacturing Company's exhibit occupied more than 4,000 square feet in the rear of the building, where they showed a variety of their equipment in actual operation. Inside the hall miniature models demonstrated the application of mechanical appliances to the production of coal from face to tipple.

Every section of coal-producing districts in the United States was represented. From the Pacific coast, the Rocky Mountain region, the Central fields, and the anthracite district, from East, West, North, and South they came in large numbers to participate in this great meeting. England, Norway, Belgium, France, Japan, Germany, and Canada also were represented.

Everywhere was evidenced a cooperative spirit, an earnest desire on the part of operator and manufacturer to reach a solution of coal production problems. The feeling is growing steadily, from year to year, that the problems of the practical operating man can only be solved through the adoption of mechanical appliances; that the day of less men employed in coal mines, with higher wages per man, is rapidly approaching.

H. K. Porter, Hyatt Roller Bearing Co., Elected President of the Manufacturers' Division of the American Mining Congress

It was a great gathering and much good will accrue to the industry because of it.

The formal opening of the National Exposition of Mine Equipment took place on Monday evening, May 24. There was no program arranged, although hundreds of delegates already in Cincinnati for the opening of the convention, Tuesday morning, were present and inspected the exhibits.

There was no official program for Monday, the 24th. Two sections of the National Standardization Division, of the American Mining Congress, held informal conferences, at which was discussed mechanical loading and mine timbering.

At the meeting of the Mechanical Loading Section of the Standardization Division, L. E. Young, president of the Union Colliery Company of St. Louis, was elected chairman to fill the vacancy caused by the death of Howard M. Ernst. This section held three meetings during the convention, adopted a program under Dr. Young's leadership, and listened to the progress reports of the sub-chairmen, T. E. Jenkins, Vice President, West Kentucky Coal Company, chairman of Committee No. 1, Loaders; A. P. Cameron, Vice President, Westmoreland Coal Co., chairman of Committee No. 2, Conveyors; G. B. Southward, Consulting Engineer, Elkins, W. Va., chairman of Committee No. 3, Methods of Mining with Mechanical Loading. The preliminary work of the

committee will be the correlation of information concerning these subjects, and the presentation of a progress report to the Seventh National Standardization Conference to be held in Washington in December.

The Mine Timber Section was reorganized at its meeting. R. E. Krape, Rochester & Pittsburg Coal & Iron Co., was elected general chairman. The committee voted the organization of a subcommittee on reforestration, and authorized the enlargement of the present personnel of the section.

A meeting of the Board of Governors of the Manufacturers Division of the American Mining Congress, under whose auspices the convention and exposition were held, occurred on Monday, May 24, at the Gibson Hotel, Cincinnati, Ohio.

The meeting was called to order by J. C. Wilson, Ohio Brass Co., chairman of the division. After approval of the financial statement presented by J. F. Callbreath, secretary of the American Mining Congress, a change in the by-laws of the division was proposed, seconded and carried. This change provides for the holding of the annual meeting of the Manufacturers Division during the week and at the place the convention and exposition are held.

The following officers were elected to serve during the current year: H. K. Porter, Hyatt Roller Bearing Co., chairman; H. A. Buzby, Keystone Lubricating Co., first vice-chairman; C. L. Herbster, Hockensmith Wheel & Mine Car Co., second vice-chairman; F. J. Maple, John A. Roebling's Sons, third vice-chairman; J. C. Wilson, Ohio Brass Co., honorary chairman.

The members of the Board of Governors, as elected at this meeting, are: L. W. Shugg, General Electric Co.; N. S. Greensfelder, Hercules Powder Co.; H. K. Porter, Hyatt Roller Bearing Co.; H. A. Buzby, Keystone Lubricating Co.; Raymond Mancha, Mancha Storage Battery Co.; Charles Whaley, Myers Whaley Co.; J. C. Wilson, Ohio Brass Co.; F. J. Maple, J. A. Roebling's Sons Co.; H. F. Reck, Streeter-Amet Weighing & Recording Co.; C. R. Delamater, W. S. Tyler Co.; Rex Martin, Link Belt Co.; C. L. Saunders, Morse Chain Co.

The convention opened on Tuesday morning, May 25, with the opening session devoted to discussion of stream-pollution problems. The proceedings of this session will be found in full in this issue. Tuesday afternoon session was devoted to discussion of shearing and blasting. The proceedings of this session will appear in full in the July issue of THE MINING CONGRESS JOURNAL. Both sessions on Wednesday and the Thursday morning session were given over to the discussion of mechanical loading problems, and the proceedings of these sessions appear in full in this issue. On

Phil H. Penna

Wednesday evening the exhibitors gave their annual smoker, which is the event at which the exhibitor is host to the operating men. A large number attended.

Accident Prevention was the subject discussed Thursday afternoon. The proceedings of this session will appear in full in the July issue of THE MINING CONGRESS JOURNAL, as will the proceedings of the two sessions on Friday, which were devoted to Roof Control and Mining Methods, and Underground Transportation.

The informal dinner given by the American Mining Congress on Thursday evening was a very happy event. Herbert Wilson Smith, Union Carbide Co., New York City, acted as toastmaster, the principle speakers being the Hon. Joe

Herbert Wilson Smith

J. Manlove, Congressman from Missouri, and Phil H. Penna, secretary of the Indiana Bituminous Coal Operators Association.

In his introductory remarks Mr. Smith said:

"We have seen in this convention something of what is being done for the industry. We know that a coal mine is a factory underground and must operate under the same economic factors as any factory. It is a business that can and must work out its own salvation. With reference to congressional activities, it is regrettable that because our contacts with Government and of those which touch us where we don't want to be touched give us a feeling that the Government can solve everything or be blamed for everything. When we pin ourselves down to the people we know and who are serving us personally we see that they are fine people."

MR. PENNA'S ADDRESS

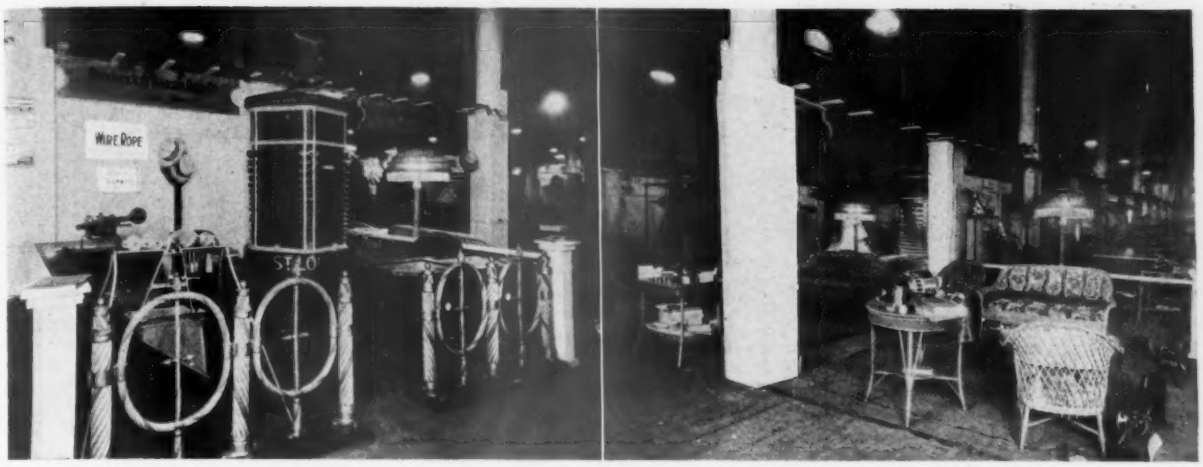
Mr. Penna was very definitely of the opinion that the coal industry will work out its own problems if it can remain unshackled long enough to do so. In part, he said:

"I can not help but reach the conclusion that we are not so sick an industry as we sometimes think. We are not such a badly functioning institution as we sometimes appear to other people, and other people tell others we are. Answering the question or the answer to the question, 'Is the coal industry a badly functioning institution,' depends on what we mean by the coal industry. If it comes to the merchandising end, I have but little to say in its defense. I do not see very much advancement, if any, since the first time I became acquainted with it, 45 years ago. Cheap, cheaper, and cheapest! Coal, the cheapest in the world, and still we are trying to make it cheaper, and we merchandise our coal on the basis of how cheap we can put it out; how cheap it can be handled without reference to its value. I am not talking about the merchandising of coal, but the producing of coal.

"Our industry is not a badly functioning industry. Our industry is not an inefficient, unorganized industry. When it comes to the producing end of coal, we have made wonderful strides and progress. We have learned to mine more coal per acreage, more coal per day, less accidents, less damage to life, and we have learned when called upon to do so, as we were recently called upon by our nation, to bury this nation in coal.

"I want to read an excerpt to you to show how old or how new those things are about our industry:

> " 'That strikes and lock-outs have become evils of the greatest magnitude not only to those men concerned but to general society, involving a war of capital and the impoverishment of



labor. The question of what one should pay and the other receive can be best determined by friendly conference where intelligence and arbitration will take the place of the irrational and cruel methods of the past. The widespread depression of business, the over-production of coal, and the severe competition have caused the capital invested in mines to yield little or no profitable return, the constant reduction of wages that has lately taken place has offered no relief to capital and has tended to increase its embarrassment.'

"That was written on or about the 15th of October, 1885, and that grew out of a circular that was written in September of the same year. That was signed by Col. A. L. Sweet, of Illinois; D. J. Jenny, coal operator of Indiana; W. P. Wren, of Pittsburgh and Ohio; and also by C. Evans, of Ohio; Daniel McLaughlin, of Illinois; and Mr. Flemming, of West Virginia. That was a long time ago. We were afflicted then, as now, with the same troubles. Those men went to work to relieve the situation and started what has since been termed collective bargaining. In 1886 a scale of wage, incorporating arbitration, conciliation, no strikes (only as a case of last resort) was put in operation. Under Secretary Davis only 14 percent of the time lost at coal mines was due to strikes or lockouts and the other 86 percent to other things. The people of America have never suffered, except in one or two cases, any inconvenience from the failure of operators and miners to supply the nation with coal.

"Why are we held up to public ridicule and abuse? Where is there any industry in the United States that functions any better? If there is, show me one. United States Steel don't; the copper industry don't; boots and shoes don't; the agricultural industry don't. Where are they that do? Where are they that function any better measured by our actual performance in ratio to our potential performance? We work a greater part of the time than they do. We produce nearer our potential production than they do.

"Our collective bargaining continued until Government broke us up. The nation, the operator, and miner were the beneficiaries. The whole country was the beneficiary until Government broke us up — the Government of the United States. We met and agreed as usual in 1916. We made a contract in 1916 with the coal miners of this country that gave to the people all the coal they wanted at from $1.15 to $1.30 per ton up until 1917. Then faddists declared there was such a thing as an American standard of living and men were not to be paid any more based on service rendered, but out of some imaginary fund, irrespective of the price of the commodity.

"Government broke us up. Since that time we have done what we have been told to do by the Government. To that extent we are in trouble today, surrounded by disputes, with the past more or less distasteful, and the future uninviting.

Hon. Joe J. Manlove

"The United Mine Workers of America is not the labor union that said 'Arbitration, friendly conferences'; that was said by its predecessor. The union has been taught that what it can not get out of the coal operators in conferences, by argument and reason, it can get out of the Government. In 1917 wages were increased twice by Government edict. In 1919-1920 increased again, and we were ordered to make a scale of wages with the miners. We did it. In March, 1920, the contract was signed, sealed, and delivered and then by order of the President we assembled again in August and increased that scale $1.50 per day. If the Government keeps this up they will come to the place where they will have to subsidize the coal operators, like they did in England, in order that the coal operator can pay the miner big wages.

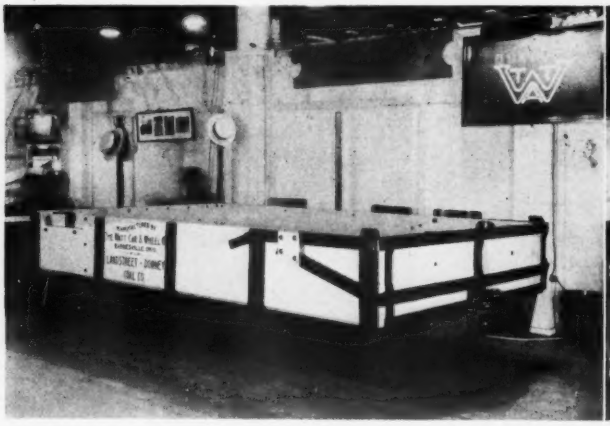
"What we want is to be let alone and be free as long as we are decent. When we fail to be decent we don't care how quick you put the curb on. We wish to be governed by the same rules, ambitions, desires, likes and dislikes, and to be governed like humans.

"Mr. Hoover recently said: 'I believe that if left alone the coal industry will solve its own difficulties.' If left alone—that is what we want. We ask no favors."

Address By Mr. Manlove

Congressman Manlove advocated changes in the Sherman antitrust law, saying:

"Your problems are to a very great extent the problems of every American. Upon your success depends the welfare, prosperity, and happiness of more than half a million miners and their families. Your output is the very life-blood of all American industry, and the man is short-



sighted indeed who does not wish for your peace and prosperity.

"Only through organization, discussion, and agreement will you be able to cope with the troublous waters of the sea of difficulties which now confront you.

"Last May at Atlantic City I addressed the annual convention of retail coal dealers. Speaking broadly, I said it was necessary for the coal industry generally to keep in close touch with the people and their Representatives in Congress; that the people were demanding some assurance of stabilization of prices and insurance of continuous and adequate supply, as against coal famines and consequent skyrocketing of prices. I intimated that it might be better to meet Congress at a round table and agree upon legislation enacted in peace time, or show why none should be enacted at all, than to be forced to accept hastily enacted legislation which might come in days of pressure and excitement. I was taken to task to some extent by certain spokesmen for the industry. They told me I was wrong; that there was no pressure on Congress from the people; that there would be no immediate attempts at Federal legislation affecting coal.

"In presenting the situation as I saw it then, I was speaking as a friend. I am speaking now as a real friend when I call attention to the fact that my deductions were correct. More than 50 different bills relative to the coal industry have been introduced in the House of Representatives alone during the present session of Congress. Extensive hearings have been held before the Committee on Interstate and Foreign Commerce in the House. In the Senate a bill has been reported and is now on the Senate calendar. A hasty resume of the purport of the House bill recently introduced by the chairman of the Committee on Interstate and Foreign Commerce may interest you.

"The bill bears the title 'To protect the Government and public from shortages of coal.'

"Section 1 provides authority to the Bureau of Mines to gather, analyze, compile, and make public statistics relating to mines, employes' rates and wages, production, marketing, distribution, and other information under certain conditions.

"Section 2 provides, in subdivision 'A,' for the collection of facts and statistics relating to the coal industry and the publication of summarized reports of such facts; however, treating as confidential all individual figures and showings.

"Subdivision 'B' and 'C' vest authority in the Bureau of Mines to examine books and records and prescribe a penalty for failure of any person to refuse access thereto.

"Section 3 has reference to coordination of certain of Government departments and bureaus.

"Section 4 has reference to administrative features.

"Section 5 vests authority in the President, under certain contingencies, to direct the Secretary of Labor to conciliate differences, encourage arbitration, or act as mediator. It also gives the President authority to establish temporary boards of mediation and clothes the mediation agency with certain authority.

"In order that we may grasp the full significance of the next section, it may be well to consider Subdivisions A and B in their entirety.

"Section 6 of the act entitled 'An act to declare a national emergency to exist in the production, transportation, and distribution of coal and other fuel, granting additional powers to the Interstate Commerce Commission, providing for the appointment of a Federal Fuel Distributor, providing for the declaration of car service priorities during the present emergency, and to prevent the sale of fuel at unjust and unreasonable high prices,' approved September 22, 1922, as amended, is amended to read as follows:

"'Section 6. (a) Whenever the President is of opinion that it is in the public interest and is necessary in order to protect against shortages or possible shortages of coal, by reason of a lockout or strike or the possibility of a lockout or strike affecting a substantial decrease in the production of coal, he shall by proclamation declare that an emergency exists.'

"Other provisions of the bill relate to issuance of proclamation by the President declaring that the emergency has passed.

"Many questions will be presented as to the constitutionality of the different provisions of this proposed act. Some extremely able arguments have been presented before the committee both for and against the advisability and legality of this proposed measure, but time will not permit any lengthy discussion thereof.

"It may not be amiss to survey some of the economic and social factors which have occasioned this proposed legislation.

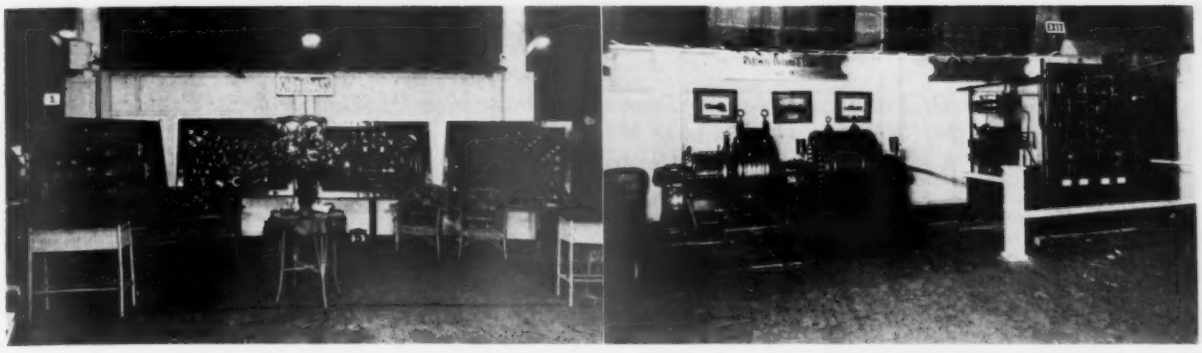
"The public is always more or less anxious concerning the possible suspension of production, with attendant shortage in fuel, and increased prices which follow as a natural result.

"The nervousness on the part of the people, occasioned by recent disturbances and high retail markets, is being reflected in this proposed legislation.

"It may be argued that there has been no reason for any anxiety on the part of the public, yet it is a little hard to appease the consumer with an analysis of figures when he feels that he has been forced to pay an exorbitant price for his fuel supply. He is not satisfied by being told that the bituminous operators have lost money on their output.

"The people generally believe that so long as we are to have strikes and lockouts with consequent profiteering, that the public should have some guarantee of protection.

"Different schools of thought vary widely. Some believe in compulsory arbitration, some in Government control of the mines, and many believe only in



'emergency' authority relative to distribution.

"To say the least, the coal industry as a whole may well conclude one of two things—either convince the public that it is able to insure it against periodical shortages and profiteering in coal, or prepare to meet the requirements of some legal enactments.

"I am frank and fair when I say that unless Congress is reassured you may prepare for a continued deluge of regulatory proposals.

"Remember I am not taking credit for nor advocating any proposed legislation. I am just explaining the situation as I have found it.

"In the last analysis, however, I am not sure but that some Federal mediation machinery might be a good thing for the industry. Mediation has proven of advantage in the past and might prove valuable in the future. At least, the machinery would be available for the purpose of bringing about amicable arbitration where accepable.

"Certainly there are few people, indeed, who propose compulsory arbitration. It is well established that no one can force either the employer or employe to work against his will.

"Aside from this recitation of the possible Federal legislative outlook, let us survey as tersely as possible some of the basic problems confronting the bituminous industry.

"Without delving into tedious figures, we probably all agree that the capacity of bituminous production is 50 percent above the demand; that there are probably 200,000 more men employed than the required output demands; that the present competition between high cost and low cost mines must eventually bring bankruptcy to the former and an unstable condition to the latter.

"Bearing these conditions in mind, it is evident that there must be closer organization before there can be a continued prosperity to the industry.

"Next we are confronted with the question as to how far such organization can go toward control of production without running into the stone wall of the anti-trust law.

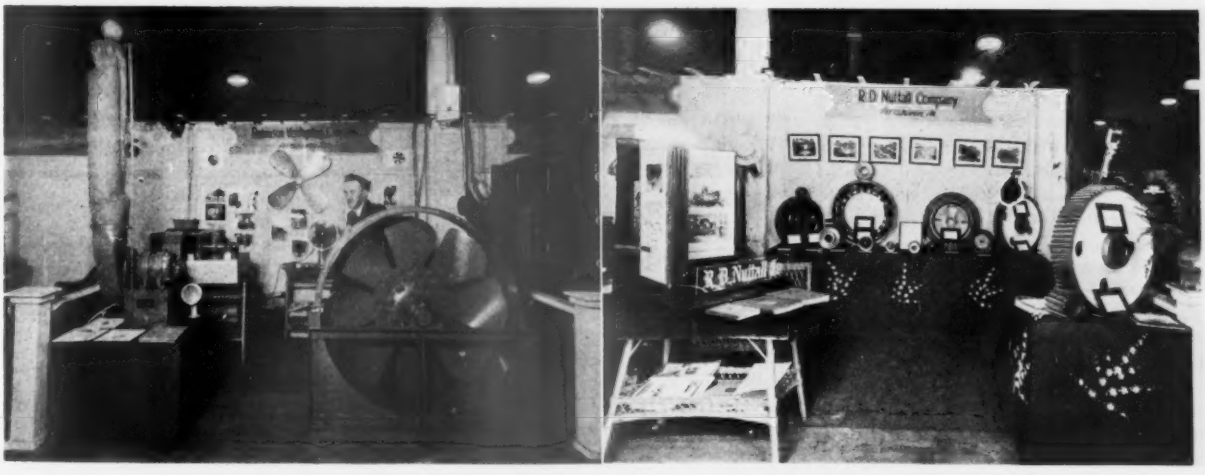
"Undoubtedly the enactment of more elastic provisions of the anti-trust laws which would permit, probably under Government supervision, such agreements and consolidations as would tend to stabilize the bituminous coal industry would be to the interest of the producer, the miner, and the public.

"Our laws should seek to encourage the conservation of our natural resources. Such consolidation as would insure the continuous operation of the low-cost mines would insure steady employment for labor wastage. Without losses incident to part-time operation we would naturally have a lower cost of production and consequently cheaper coal to the consumer.

"In referring to the continuous operation of the low-cost mines, it will be necessary to take into consideration the prospective demand and then fix the price of coal on the basis of the highest cost mine production which is necessary to fill the market requirements."

A rising tribute of respect to the late Daniel B. Wentz, formerly president of the American Mining Congress, was given. Mr. Hugh Shirkie, recently elected president of this organization, was given an ovation on this his first public appearance in the capacity of president. A vote of thanks was also extended J. F. Callbreath in appreciation of the construction work being carried on by his organization.

Leland Russell van Wert, for the past six years a member of the faculty of the Harvard Engineering School, has been named assistant professor in metallurgy at the Carnegie Institute of Technology for next year as a further step in the re-organization of the Department of Mining and Metallurgical Engineering.



STREAM POLLUTION AND THE COAL MINING INDUSTRY

Opening Session Of Cincinnati Meeting Devoted To Discussion Of Mine Drainage Problems, Including Papers On "Relation Of Drainage From Mines To Stream Pollution," "Mine Water Purification" And "Restriction Of Stream Pollution"

ONE of the serious problems confronting the coal industry is that of stream pollution. The papers presented to the opening session of the Annual Meeting of Practical Coal Operating Officials, at Cincinnati, May 25, are real contributions to this subject, and should prove of great assistance in helping the industry meet this problem.

***SAMUEL A. TAYLOR**, Mine Operator and President of the American Institute of Mining and Metallurgical Engineers*, presided at the session devoted to this subject. Mr. Taylor pointed out that:

S. A. Taylor

"Some of the mines which are exhausted, especially around Pittsburgh, are still pouring out water that is very much more acid than the water coming from the mines that are in operation. I know of a recent case where the whole works was dammed up to prevent water getting into a stream, but it finally seeped through and was much worse than it would have been if they had not kept it under control."

RELATION OF DRAINAGE FROM MINES TO STREAM POLLUTION

***ANDREW B. CRICHTON**, Consulting Engineer, Johnstown, Pa.:*

I am not sure what the subject—"Relation of Drainage from Mines to Stream Pollution"—means, but I know that mine drainage is one of the worst offenders we have to contend with. Mine drainage stream pollution has long been a problem locally, but recently because of important Court decisions adverse to the coal mining interests and because of pending legislation, it has become of national importance.

In many coal mining communities domestic water supplies have been polluted with acid mine drainage, resulting in their abandonment and requiring the water company to find new sources of supply. The water companies would move higher up stream above the coal mines, or other source of pollution, or, in some cases, would go far afield at great expense to obtain satisfactory supplies.

No subject, to my knowledge, has apparently been so misunderstood as that of mine drainage stream pollution. Misleading statements regarding it have been published and broadcast by radio by prominent National and State officials. Officers of sportsmens clubs, conservation leagues, Isaac Walton leagues, fish commissions and others have erroneously stated how simply and inexpensively this matter can be remedied. Prominent mining officials and engineers and water works engineers have misunderstood the problem and have made statements which are bound to confuse the public, and may result in ill advised legislation if not corrected.

After several years study of this problem, I feel safe in saying there is now no known satisfactory solution of this problem or method of treatment of acid mine drainage. If it could be treated satisfactorily and the water be made fit for use at a cost of a few cents per ton, as claimed by some Government officials, it would certainly not be objected to by the coal industry once they learned the need for preserving our fresh water supplies.

At present nearly all the important streams of Central and Western Pennsylvania are seriously contaminated from acid mine drainage. Most of these streams, 20 years ago, were used for domestic water supplies, and are now unfit for any use.

Pittsburgh, the center of one of the greatest mining and manufacturing districts of the world, is almost entirely dependent upon the Monongahela and Allegheny Rivers for its water supply. The water in these rivers, due to mine drainage and manufacturing wastes, is now acid for certain periods of the year, and is gradually growing worse. In an article on this subject in 1923 I made the statement, since widely quoted, that of the 7,000 square miles of coal on the drainage area above Pittsburgh only 400 square miles had been mined out. If mining but 6 percent of the coal has made the flow from that entire area acid during a good part of the year, it will be but a comparatively short time until the stream is acid all the year, and eventually it will be totally destroyed beyond recovery.

At present the total quantity of mine drainage is small as compared with the total stream flow in our rivers, so that the natural alkalinity of the fresh water neutralizes and renders harmless large quantities of mine drainage. One gallon of the average mine drainage will destroy the natural alkalinity of 80 to 100 gallons of fresh water.

Practically all mine drainage is acid. Of over 300 mines examined in Central Pennsylvania, only four were found to produce alkaline drainage, which could be accounted for by dilution or by contact with limestone. Rainfall is the source of all surface and underground waters. Of the total rainfall 40 to 50 percent is run-off, reaching the streams almost immediately, and of the balance only about 25 percent penetrates into the ground, a portion of which becomes mine drainage. Only a small portion of the percolating waters reach great depth, so there is less water in deep mining than is encountered in shallow mining. Mine development is constantly increasing, producing more acid mine drainage, leaving less alkaline water in the streams with which to neutralize the mine water. The more mine drainage, the less fresh water, and with the constantly growing demands for fresh water for domestic and industrial needs, the situation requires attention.

Andrew B. Crichton

Our largest industries and public utilities have suffered most from mine drainage stream pollution, because of their large and growing needs for pure water supplies. Nearly one hundred water companies in Pennsylvania have also similar problems, which are daily becoming more serious.

For years the mining industry has been considered paramount, but we are forced to admit that while coal is necessary, we *must* have water for our very existence; that one is dependent upon the other, and that both are vital to the welfare and prosperity of our nation. The development of the coal industry has gradually progressed during most of the past century, and can not be said to have nearly reached its maximum. It

has been a mighty industry to the welfare and security of our nation, as only the recent World War could demonstrate. Whatever ills have come with it have likewise been long in developing, so that good judgment and patient investigation, rather than drastic legislation, should govern in handling this problem.

Mine drainage necessarily follows coal development, and any apparent disregard of the rights of others or the protection of water supplies may in a measure be attributed to the principle laid down by Pennsylvania Supreme court in the now famous Sanderson case.

In 1886 Sanderson bought a property in the city of Scranton through which flowed Meadow Brook, a pure, unpolluted stream. He built a dam and developed a water supply for his own use. The Pennsylvania Coal Company at about the same time opened a coal mine, which soon produced acid mine drainage, destroying the use of this water. Sanderson brought suit for damages resulting from loss of the stream. The case was twice tried in the Courts of Lackawanna County, Pa., and was twice before the Supreme Courts of Pennsylvania. The first Supreme Court decision affirmed the lower Court's award of damages to Sanderson; Justice Paxson filed a strong dissenting opinion, which was sustained in the second Supreme Court decision. The Court took the position that if Sanderson could collect damages, every riparian owner thus affected could do likewise, and if they could collect damages they could also enjoin the pollution of streams by mine drainage, which would practically stop all mining operations, except by consent of the lower riparian owners; that trifling inconvenience to particular persons must sometimes give way to the necessities of a great community, especially where the leading industrial interest of the State is involved. The Court further stated in his opinion that the Coal Company was making the natural and ordinary use of its property; and that Sanderson, with others, was then securing an abundant supply of pure water from other sources, but that he would not say that a case "may not arise in which a stream, from such pollution, may not become a nuisance, and that the *public interests* as involved in the general health and well being of the community may not require the abatement of that nuisance."

The Pennsylvania Railroad 40 years ago had to give up a water supply at Portage, Pa., due to the mine drainage pollution. They are one of the largest users of water in the State, and from time to time ever since have had to seek new sources of supply as old ones become unusable from mine drainage pollution.

Shortly prior to 1905 the country suffered a severe drought, old sources of supply had become polluted, attempted treatment of the water in large quantities was unsatisfactory, resulting in numerous engine failures, so that the railroad was compelled to haul water at great expense and subsequent delays in operation. Millions of dollars were appropriated to secure an adequate supply for the present and future needs of the company, in the building of impounding reservoirs and hundreds of miles of distribution lines. At that time it was not possible to find ample supplies of water reasonably convenient to points of consumption that were not being polluted or were subject to pollution from mine drainage.

The Mountain Water Supply Co. was organized in 1905 and appropriated the waters of Indian Creek to supply the Pennsylvania Railroad system in Southwest Pennsylvania as far west as Pittsburgh, Pa. A large storage dam was built about four miles from the mouth of Indian Creek. The drainage area above this point is 110 square miles, of which 55 square miles is underlaid with the lower productive coal measures. At the time there were numerous small "country bank" openings for local supply for the farmers in the valley, but no commercial development of the coal lands. Several years later the Indian Creek Valley Railroad Co., constructed a standard gauge track from Indian Creek, a point on the B. & O. Railroad, up the valley to its headwaters, following which development of the lumber and coal resources began, but there was no material development until about 1917.

The Mountain Water Supply Co. and the Pennsylvania Railroad Co. have been anxious that some mutually satisfactory solution of this difficult problem be found, and they have spent thousands of dollars in an effort to find some solution that would permit the mining of the coal without the destruction of this very valuable water supply.

The operation of their entire system in Western Pennsylvania is dependent upon this water supply, and their anxiety regarding the result of the litigation is understandable. They appealed to the Courts for protection of their rights only after it was apparent the supply was gradually being ruined by mine water and there was nothing else they could do.

This case is known as the Indian Creek Pollution Suit. The Fayette County Court decided there was no public use of the water and that preventing the mining companies from discharging their water into Indian Creek would deprive them of the use of their property. The Court refused to grant an injunction restraining the mining companies from putting mine water into this stream. The Pennsylvania Supreme Court reversed the lower Court, declaring that it was not a question of property rights, but that it was a nuisance to pollute the stream, and that they should not after a certain period discharge their mine water into Indian Creek or its tributaries above the dam of the water company. This opinion was concurred in by the United States Supreme Court.

In addition to supplying the railroad company, the water company furnished water to several municipalities in Western Pennsylvania, supplying about 75,000 people.

The Court's opinion states, "It is controlled by one fact and a single equitable principle; the fact that the stream has been polluted, and the principle that this creates an enjoinable nuisance, if the public uses the water."

As a result there has been considerable discussion as to what constitutes mine drainage, or mine water. The water companies sought an injunction to restrain the mining companies from discharging acid mine waters into Indian Creek. It was admitted by both sides that eventually this mine drainage would destroy this water supply for the purpose for which it was then and is now being used. Some of the leading chemists, water works and mining experts of the United States were witnesses in that case, and there was no disagreement as to the facts: that continued pollution by mine drainage would eventually utterly destroy this stream and render it unfit for any use.

There was a great deal of testimony introduced regarding the treatment of mine water, and there was no material disagreement on that point. When a water supply contains 4 grains sulphate per gallon, (sulphates being a product of sulphuric acid pollution) it would require softening, and when the pollution exceeded 12 grains sulphates per gallon, treatment was no longer effective, because it required the introduction of so much soda-ash the waters were so heavily charged with solids as to cause foaming in the boilers. It would, therefore, be but a short time between the period when treatment was required and when treatment was no longer effective.

The neutralization of acid mine water by the introduction of lime does not make the water fit either for domestic or industrial use. This matter was clearly before the Court and was undoubtedly the reason for the decree that the mine waters be kept out of the stream. The meaning of that decree is surely that the water supply is to be preserved in condition for use, and the only way to do that is to keep the mine water, treated or untreated, out of the stream.

The difference between the Sanderson and the Indian Creek decisions is that Sanderson, an individual who had access to another good supply of water, was not permitted to stand in the way of Pennsylvania's greatest industry, while in the Indian Creek case the public, also represented by the commonwealth, is fighting to preserve one of the last available pure water supplies in the State.

I feel this decision should give much less concern to the mining industry than pending legislation.

In the Indian Creek case the water company's property is worth several times the value of the coal, equipment and development of the mining companies. The water company was established there nearly 10 years before any coal development, and notified each coal company in writing prior to development that they would be held responsible for polluting the stream.

I don't believe, because of this decision, that every water company can prevent any coal company from discharging mine water into a stream from which the water company gets its supply without the supporting facts and conditions to warrant it. However, I feel the time has come when the few remaining unpolluted fresh water streams of the State should be protected; otherwise, where will we get good water for our growing need? The policy of the Pennsylvania Sanitary Water Board, represented by W. L. Stevenson, to protect the present unpolluted streams, should have our commendation and support.

Much has been said about the cost of treating mine water, and there is much more confusion as to what is meant by treatment. The Conservation League wants a water in which fish will live, which will not kill bird life or vegetation. Every one would like the oxide of iron (which colors the beds of streams yellow) kept out of the water, and the domestic and industrial user wants a water fit for human consumption and commercial use.

The average total acidity from numerous determinations of mine water in Central and Western Pennsylvania is 80 to 100 grains per U. S. gallon. The cost to neutralize such water has been variously estimated by different chemists at from 15 to 25 cents per 1,000 gallons. This depends upon the cost of lime, the cost to gather the water to one central plant, capacity of plant, labor and the handling of the sludge which in itself is an exceedingly difficult and expensive, if not impossible proposition. The cost to construct a plant for lime treatment would be about $100 per 1,000 gallons daily capacity, or for a 1,000,000 gallon plant, $100,000.

From measuring the flow of mine drainage and comparing it with the coal area exhausted in nearly 200 mines in Pennsylvania, we find the average yield to be 1,000 gallons per acre per day. A recent estimate of the acreage worked out in the bituminous mines of Pennsylvania, based on the total tonnage produced would indicate a total daily production of mine drainage of 750,000,000 gallons.

The cost to build lime treatment plants for this enormous quantity of water would be $75,000,000. The annual cost of treatment at 15 cents per 1,000 gallons would be $41,062,500 and at 25 cents per 1,000 gallons would be $68,437,500.

The estimate by Charles Dorrance of mine drainage reaching the streams from anthracite mines is 700,000,000 gallons daily, so that the above estimates for the entire State of Pennsylvania would be about doubled.

It must be understood the above cost is for neutralization only, and that even after this treatment, which is the one most often referred to, the water is still unfit for either domestic or industrial use. To soften the water would cost more than double the above estimate for neutralization, and even with that the value of the product would be doubtful.

It will be seen, with an annual production of 120,000,000 tons in the bituminous fields of Pennsylvania, the cost will be from 34 to 57 cents per ton for neutralization, and from 70 cents to $1.00 per ton for softening.

In the bituminous fields of Pennsylvania alone there would be 4,500 to 5,000 tons daily, or 1,825,000 tons yearly, of sludge to handle. Even if dried and piled outside it would be likely to reach the stream beds with every rainstorm, and would eventually fill them up. This iron oxide may be used for purifying gas and in the manufacture of paint, but it has a very limited market, and with such quantities as would then be available it would be as common as dirt and without value. To mining men it would be nothing but slimy yellow mud, too thick to pump and too thin to shovel.

Mr. J. R. Campbell, formerly chief chemist for the H. C. Frick Coke Co., who built and operated the lime treatment plant at the Calumet Mine, has verified the above figures as to cost of treatment. Mr. Campbell has long been interested in this subject and probably knows more about it than any one else.

With these tremendous costs in Pennsylvania alone, the cost of treatment for the coal industry throughout the Nation would be staggering, and never could be justified.

The Stephens bill, H. R. 8310, introduced at this session is an amendment to the Rivers and Harbors act of March 3, 1899. It is similar to the Rosenbloom bill of the last session. It makes it unlawful within the limits prescribed by the Secretary of War to discharge any free acid into navigable waters or their tributaries. It places in the hands of the chief of Army Engineers the power to require neutralization of acid water or wastes, and provides a fine for each offense of $500 to $2,500, or imprisonment of not less than 30 days or more than one year.

The State and individuals have spent thousands of dollars in an attempt to solve this problem, but without success, so that the time has surely come for wise governmental action, not the hasty passage of drastic laws as now proposed that would so greatly embarrass the mining and manufacturing industries, but a sane public policy that will tend to preserve our water supplies at as little cost to the community as is possible. Secretary Hoover's suggestion of a careful investigation of the entire problem before the passage of legislation, is wise, and should not only have the approval but the hearty cooperation of the entire coal industry. Unless some mutually satisfactory solution of the problem is soon found, endless litigation may result between the water works and mining interests.

One thing seems certain, and that is we can not mine the coal without destroying the water in the mining regions. Therefore, I feel the only sure and practical method of conserving the water supply is to stop mining coal in some little developed areas yet remaining. This can not well be done as between individuals, and I think the Government or the State is justified in purchasing, if necessary, under some plan to be devised, coal lands necessary to the protection of our few remaining water supplies in Western Pennsylvania. That the State recognizes the importance of this problem is evidenced by their participation with the water companies in the Indian Creek case.

The over-development of the coal industry is so apparent that it seems to me here is an opportunity for a worth while beginning. I can not see that the coal industry is particularly to blame. What they have saved thus far by their failure to take care of the water has been passed to the public, as the industry for a long period of years has not been profitable.

MINE WATER PURIFICATION

JAS. O. HANDY, Director, Pittsburgh Testing Laboratory, Pittsburgh, Pa.:

In 1925, on an appeal by the Pennsylvania Railroad Co., from a decision by the lower Court in favor of certain coal companies, it was directed by the Supreme Court of Pennsylvania that the Court below "shall enter decrees enjoining and restraining" the Sagamore Coal Co., the Melcroft Coal Co., and others, from "discharging, pumping, or causing or permitting to flow or to be discharged, any drainage of mine waters from their mines" * * * "into the waters of Indian Creek or its tributaries above the dam of the Mountain Water Supply Co."

Six months were allowed, presumably for the construction of a tunnel to convey all mine water to a point below the water company's dam.

The Court declared the draining of coal mine water into a stream already in public use as a water supply, to be a nuisance which must be restrained.

The representatives of other users of water below the point at which the Court decision permitted the defendants to deposit their untreated mine water, have expressed their reluctance to have the nuisance passed on to them.

If the untreated or the treated water from the mines on Indian Creek can not legally be deposited anywhere, coal mining can not be carried on there. Water is an unavoidable by-product of coal mining.

It is however, evident from a study of the decision of the Court in the case just referred to that it was the discharge of "*acid* mine waters" (p. 3), or drainage "greatly *contaminated with acid*" (p. 6) which was enjoined, and that "without water uncontaminated by *acid*, the railroad could not be operated." (p. 8).

Since all coal mine water is not acid, and since any mine water may be freed from both iron and acid, there arises the necessity for defining coal mine water.

A study of the composition of coal mine waters shows that they usually contain, in addition to calcium and magnesium compounds, common to ground water, iron sulphates and free sulphuric acid. These are the constituents which characterize most coal mine waters, and cause their introduction into certain streams to be objected to.

If coal mine waters are not acid, or if by treatment with hydrated lime, for example, iron salts and acidity are both removed, the water flowing from such treatment plants can no longer be indiscriminately called coal mine water or drainage with the implication which the name conveys.

Confusion has arisen due to the fact that the terms "coal mine drainage" and "coal mine water" have until now carried with them the ideas both of *source* and of *composition*. Source is descriptive, but unimportant, when one considers that certain coal mines yield water which is alkaline and free from iron sulphates. It is water which is corrosive because of the acid substances it contains, and which turns red because of the deposition of iron compounds when it flows in streams, which is to be distinguished from water which has neither of these properties.

J. O. Handy

The following definitions are proposed:

Coal Mine Water, or Drainage: Water which enters the coal mine workings and afterwards runs or is pumped therefrom. Characteristic constituents are free sulphuric acid and iron sulphates derived from iron sulphide in the coal (pyrite) by oxidation and solution.

Naturally Purified Coal Mine Water: Water which because of subsequent contact with limestone has lost the iron and the acidity which it had.

Artificially Purified Coal Mine Water: Water which has been treated with pulverized limestone or hydrated lime so that iron has been removed and acid neutralized.

Characteristics of Purified Coal Mine Water: Water which does not corrode metals nor injure fish, nor stain stream beds or banks. It is coal mine water neither in its composition nor characteristics. It is purified water, just as much entitled to respect and confidence as is any other natural water requiring and receiving treatment.

Purified Coal Mine Water Not a Nuisance: The characteristic constituents of coal mine water having been removed or changed in nature, the introduction of such water into streams is not a nuisance. No disease germs and no free acid or acid substances are introduced.

Hardness of Coal Mine Water: The term "hardness" is synonomous with soap-destroying power, and the removal of the characteristic objectionable constituents of mine water does not materially change the soap-destroying power of such water. Such change as does occur is in the direction of diminution of hardness.

Purified Coal Mine Water For Boiler Use: Any objections made to the introduction of coal mine water purified by lime treatment into streams are based on the idea that at low water stages the proportion of sulphate of lime may rise high enough to make the water objectionable for boiler use, even when further purified by soda-ash treatment at the point of use. This is not relavent to the discussion of the question whether the introduction of purified coal mine water is a *nuisance*. Lime or calcium compounds are almost universally distributed, and are found in practically all ground waters. No trade waste or industrial by-product has ever, to our knowledge, been debarred from streams because it introduced so much lime into the stream as to render it unfit for boiler use. It is not proper to introduce such a consideration into the coal mine water purification field.

Mine Water Purification: The chemical reactions by which iron sulphide in coal is oxidized in the presence of air and water to iron sulphate and free sulphuric acid may be considered to take place about as follows:

(1) $2FeS_2+7O_2+2H_2O=2FeSO_4+2H_2SO_4$
(2) $3FeSO_4+O_2+H_2O=Fe_2(SO_4)_3+FeH_2O_2$
(3) $4FeH_2O_2+2H_2O=2Fe_2H_6O_6$

Coal mine water as it leaves the mine may still carry nearly all of its iron in the form of ferrous sulphate (Equation 1). The free sulphuric acid is later partly neutralized by reaction with aluminum, calcium and magnesium which are contained in slate, limestone, shale, etc., with which it comes in contact.

If there is opportunity for aeration as the water flows along, the change to ferric sulphate takes place in some degree (Eq. 2). This is accompanied by the deposition of ferrous hydrate which quickly oxidizes in the presence of air to ferric hydrate (Eq. 3). Coal mine water thus contains in solution ferrous and ferric sulphates, and sulphates of calcium, magnesium, aluminum, sodium, and manganese. It contains also insignificant amounts of silica and of sodium chloride.

In suspension, if equations 2 and 3 have come into action, ferrous and ferric hydrates are found. They give the water a greenish yellow or brownish color, according to the proportion of each. It is the deposition of these suspended iron hydrates which discolors the beds and banks of streams.

The free sulphuric acid being only partly neutralized by the bases in the materials with which it comes in contact, mine water finally contains both free sulphuric acid and acid sulphates. Acids and acid sulphates are both corrosive of metallic structures, such as boiler tubes, etc.

The problem of mine water purifica-

tion therefore consists in the complete neutralization of the free sulphuric acid, the decomposition of the acid sulphates which the water contains, and the removal of suspended hydroxides of iron, etc., resulting from the process.

Theoretically, a number of purifying agents may be used. Practically, only lime is cheap enough to warrant its use at the present time, when but one small section of the coal mining industry is being called upon to purify its mine water. If the burden were generally distributed, and the public, whose streams are being protected had taken over the burden in the matter of increased cost of coal due to the chemical purification of mine water, it would be fair to every one concerned.

Furthermore, it is not to be expected that the purification of any trade waste will go further than the removal of the characteristic substances which make the water objectionable. In coal mine water, these substances are iron and aluminum sulphates and free sulphuric acid. The latter is neutralized, and the former removed by lime treatment.

The most practicable method on the ground both of cost and convenience is treatment of coal mine water with dry hydrated lime, fed mechanically to the water in predetermined proportions based on the total acidity of the water. Mechanical lime proportioning and feeding devices are available which are very reliable and after the mixture of mine water and lime has been completed by flowing through a box containing baffles, the problem is to allow sufficient time for the reactions to be completed and for the precipitate or sludge to settle out from the purified water which flows away free from acid or acid sulphates.

The time allowed should never be less than four hours, and a longer time is often beneficial.

The device which is most satisfactory for the separation of the sludge from the water is known as a thickener. The precipitate settles on the inclined bottom of a tank and is drawn by a rotating device toward the central opening from which it is pumped away. It then contains about 75 percent of water and by further settling can be relieved of a part of this and fed to a drying device.

The material thus recovered can be used as a purifier for removal of sulphur from manufactured gas, or it may be used as a paint pigment. Other uses will probably be found, and the income from these sources will pay part of the expense of treatment.

A typical mine water analysis from mines in the bituminous coal region of Western Pennsylvania is as follows (parts per million):

Total acidity, expressed as $CaCO_3$	1487
Free sulphuric acid, expressed as $CaCO_3$	800
Iron	425
Sulphate (SO_4)	2646
Aluminum	94
Calcium	346
Magnesium	84
Sodium	83
Chlorine	10
Silica	70

Analyses of mine water before and after treatment with hydrated lime at the plant of the Melcroft Coal Co., are as follows (Acidity and alkalinity expressed in p. p. m. as $CaCO_3$):

	Raw	Treated
Total acidity	940	....
Alkalinity	....	5
Sulphate (SO_4)	1600	1500
Iron (Fe)	250	2
Aluminum	5	1
Calcium	200	630
Magnesium	78	43
Silica	40	8

The results of operation between February 28 and April 17 at the Melcroft Coal Co., plant are shown in the following table (p. p. m.):

	Raw		Treated	
Date	Acidity	Sulphate	Alkalinity	Sulphate
2/28-3/6	820	1700	8	1700
3/7 -3/13	820	1600	10	1500
3/14-3/20	890	1600	7	1500
3/22-3/27	800	1600	6	1500
3/28-4/3	820	1600	9	1500
4/4 -4/10	820	1600	8	1500
4/12-4/17	780	1500	10	1500

The average acidity shown above corresponds to a consumpiton of 5.74 pounds of 90 percent hydrated lime per 1,000 gallons. The consumption probably more nearly approximates 6 pounds per 1,000 gallons. There is some mechanical loss, and some of the lime is covered up and does not enter into reaction.

The yield and composition of the dry sludge obtained at Melcroft by hydrated lime, and at Calumet by powdered limestone treatment were as follows:

	Melcroft	Calumet
Dry sludge per 1,000 gallons	7 lbs.	12.5 lbs.
Iron oxide	41.4%	39.4%
Aluminum oxide	5.7	11.5
Calcium oxide	9.6	7.5
Magnesium oxide	8.5	0.6
Silica	6.1	12.8
Sulphuric anhydride	9.4	12.5
Combined water & carbon dioxide	19.0	14.6
Phosphoric anhydride	not determined	1.1

Estimates of Plant and Operating Costs for Coal Mine Water Treatment

On the basis of $12 per ton for hydrated lime containing 90 percent of calcium hydroxide, each 1,000 gallons of mine water having an acidity, expressed as calcium carbonate, of 1,000 p. p. m., would require 7.6 pounds, costing $0.046, of 90 percent hydrated lime, for neutralization, if 90 percent of the applied lime enters into the reaction.

The estimated cost of erection for a 500,000 gallon per 24 hours mine water treating plant having the usual tanks, stirrers, etc., which are used in intermittent water softening operations, as of date, Nov. 30, 1925, was as follows:

	Labor	Mat'l	Total
Building, rough construction	$2,375	$2,280	$4,655
Treating plant (tanks, etc.)	1,000	12,135	13,135
Track and floor over tank	2,155	3,920	6,075
Sludge sump	2,910	....	2,910
Foundations	1,725	2,290	4,015
Third rail and trolleys	500	750	1,250
Wiring and lighting	825	925	1,750
Indirect charges	...	...	6,170
			$39,960

Operating costs, on the basis of 500,000 gallons of mine water treated per day:

Hydrated lime, 3,800 lbs., at $.006	$22.80
Labor, 3 shifts, at $4.00	12.00
Power	4.50
Chemical supervision	2.00
Interest, depreciation, etc., 15% on $40,000	16.50
Total cost per day	$57.80
Average cost per 1,000 gallons	$0.1156

In addition to the above items of construction expense, the disposition of the sludge may add $10,000 if the sludge is to be filtered and dried, making an investment total of $50,000 for a 500,000 gallon per day plant. Operating expense might be increased to $0.15 per 1,000 gallons, or $75 per day.

An important part of mine water purification consists in allowing time enough for a part of the calcium sulphate to crystallize and settle out of the water. Records show that if there is settling basin capacity for three days flow of treated water, as much as 100 p. p. m of calcium sulphate separate with the sludge.

Summary

The treatment of acid, coal mine water, so that it is no longer corrosive nor injurious to fish life, nor productive of stains on banks of streams, is best carried out by means of hydrated lime.

The approximate cost is $0.15 per 1,000 gallons. The plant for treating 500,000 gallons per 24 hours costs approximately $50,000.

The yield of iron oxide sludge is from 7 to 12 pounds per 1,000 gallons.

The coal mine water is not hardened, but is made slightly softer by the treatment.

A careful study of the conditions under which certain coal mine waters in every district are purified by natural means will be worth while. It might have important industrial applications.

Discussion:

PROF. JAMES WITHROW, *Head, Department Chemical Engineering, Ohio State University, Columbus, Ohio:*

There is no question about the seriousness, the importance and the difficulty of this problem. One would infer that Mr. Handy is interested in having us learn more about the chemical possibilities. The chemical men are of course interested in finding some form

of treatment. I think the idea Mr. Handy advanced that we must look carefully into both sides is the correct one. This organization represents the brains that must go with the overhead.

"We must go into both sides of the question. I must apparently contradict a suggestion made here today. It is not agreed at all that the sulphur comes from the water as stated. It is entirely natural that it come from the fresh coal in the mine. However, there may be exceptions which proper investigation will bring out. As Mr. Handy indicated, with more chemical study perhaps we may find some difference in operation practices that will at least abate the nuisance in part. The nuisance is like a two-edged sword. You will notice the fact that this chemical treatment proposal which Mr. Handy used as an illustration of what can be done in one direction is so successful that it permits oxygen in the water so that fish can live. This chemical treatment restores the water to a natural pristine condition. It also makes the water germ free, which is better than natural. In fact, it is a common practice in many parts of Ohio and elsewhere to treat the water for municipal use in order to make it fit for men. This treatment with lime, discussed by Mr. Handy, makes the water fit for drinking purposes and also removes the unsightly condition along streams.

"Anyone living around New England's dye streams of black ooze would become accustomed to the yellow appearance, but to us both streams look unsightly. Having made the water fit for animal life, does it hurt man's mechanical devices?

"Another thing which should be emphasized, sulphates do not mean free acid. Sulphates are natural constituents of nearly all hard waters. It is quite some time since a book was written by a professor in a New England university which stated that water as hard as 200 was known to exist. We would like to see as pure as that in Ohio. The things that I think should be investigated are whether in the presence of this sulphate the limits which have been set of 12 grains are really impossible or unnecessary limits. In certain areas we have unusually soft water, that is the absence of limestone has given us very soft waters. As you get into the far West you have waters that are quite alkaline and of a badly brining nature presumably. However, the railroads are still running out there. They realize that they must cope with that fact. I understand we have been able to cope with waters that seemed very much worse than the 12 grains mentioned. It has been very clearly shown that the mere treatment of mine water did not mend the situation. To exclude oxygen (or air ventilation) from the "country-banks" and abandon mines would be vastly better than any effort to dam up their water.

"Now about this yellow mud or sludge. We know that only a few of the suggestions made as to remedies in such cases ever materialize. It is not impossible to think of this as iron ore. Then its quantity ceases to appall. It becomes a resource. This question is one that requires vision of course, but it is possible of solution. Eventually we have got to do something. Our effort now is to find the right thing to do. Each side looks as if it had a great deal of right because it really has. The ridiculousness of this decision in Idaho of obliging the mines to restore the streams' pristine freedom from ground rock is certainly obvious to us. According to that decision, these streams ought not to get muddy. Man has inherited these streams for his use. They are one of our wonderful assets. We can't do without them, still they are getting smaller in volume as the years go on, and man has developed a capacity for turning them into sewers.

"Then we have to think of manufacturing. It is in the same position as mining. It also pollutes the streams. I am thinking of the attitude of Dr. Monger, Director of the Ohio State Board of Health. They have given considerable study to stream pollution by manufacturers. We have a law here which gives the Board of Health considerable power in the matter. There is therefore a great deal of potential danger to industry and uninformed legislation must be watched. I would like to emphasize the rational way in which Dr. Monger endeavors to protect the public interest and avoid unnecessary damage to industry. He calls together different groups of manufacturers and tells them about the stream situation, how they are gradually making the condition of streams worse and worse. He tells the industries this is their problem. The Board of Health sanitary engineers and chemists could make suggestions and then tell how to follow them.' It is much better, he thinks, that all work together. 'We want you people to think about this problem, and we will do the same. If we learn anything about it, we will tell you, and if you learn anything, you tell us. The streams belong to the State. If you want to use them, use them, but use them in a legitimate manner.' Dr. Monger is encouraging these organizations to get together and form groups for investigation and solution of their own problems in stream pollution.

CALCIUM SULPHATE NO SIGN OF ACIDITY

"Mr. Crichton objects to the denial of the statement that sulphates in a water are evidence of the actual presence of acid or its former presence. He does not discuss the fact that sulphates are natural constituents of most water and have no necessary relation to any manufacturing or industrial contamination. An industry which adds calcium sulphate to a water is but adding a constituent which is a natural one, and no more objectionable as an unnatural water constituent than treatment of water for a municipal supply by adding lime. This latter was objected to in the past by people who did not realize that lime was already a constituent of natural water, the treatment being designed merely to change the condition of that lime.

"Unhappily, Mr. Crichton cites the experience of the Cambria Iron and Steel Company regarding sulphates in water, mentioning that the sulphates were calcium and magnesium sulphates. If the citation is clearly understood it was believed to be shown by the investigation that the boilers were corroded in the presence of these substances.

"It is very important that attention should be called to the fact that Mr. Crichton's citation involves not the question of calcium sulphate but the question of the influence of magnesium compounds upon corrosion. Mr. Crichton mentioned the presence of magnesium, and it is well known and believed to be well established chemically that magnesium compounds are potential dangers in boilers as corrosive agents. This is not because the magnesium compounds are necessarily acid under ordinary conditions, but under boiler conditions at elevated temperatures they develop acidity. This is explained chemically as due to hydrolysis, or the action of water setting free the acid contained in the salt.

"It has never come to my attention that calcium sulphate has been demonstrated to be responsible for corrosion as is claimed for magnesium. The objections to Dr. Handy's chemical proposal therefore cease to have weight.

"It would be very wrong to think of salts in a water as representing an acid condition. If this were the case, then the ocean, which is rich in salt, would be an acid bath, like a pickling solution, and iron steamships would have a more interesting time than with the normal corrosion which come from soluble salts."

RESTRICTION OF STREAM POLLUTION

***WM. L. STEVENSON**, Chief Engineer, State Health Department, Harrisburg, Pa.:*

The prosperity of the United States, to a considerable extent, is predicated

upon the manufacture of products by industry and in the development of natural resources — both of which produce waste waters capable of polluting streams.

The condition of our streams is a subject in which the public each succeeding year is taking more and more interest. This is caused by (1) a recognition of the importance of conservation of water resources, (2) the increasing necessity for more and better water supplies for towns, cities, and industries, (3) the out door life of the public now made so convenient by the automobile and improved highways, which permit the city dweller to travel far from home, and (4) last, but by no means least, the insistent demand of the fishermen that all stream pollution shall cease.

The attitude of different groups of people toward these complex problems vary with their viewpoint. The idealists demand that all streams shall be restored to their pristine purity. A few industrial managers still take the position that "the public be damned" and use every possible means to prevent any interference with the discharge of wastes direct to the nearest water courses, regardless of the results to lower riparian owners and the public.

To clear-thinking people it is obvious that neither of these extreme viewpoints can prevail or succeed because they are impracticable and selfish.

For the idealists to have their way our present civilization would have to be extinguished by the elimination of sewered towns, factories, and mines. This is inconceivable.

If the selfish and indifferent ones could have their way, the water resources would be ruined and our water supplies would be destroyed—and water is essential to life and pure water to health. This position also is inconceivable.

So it is apparent that a middle course must be taken if our water resources are to be available for useful purposes and simultaneously our national prosperity is to be maintained and increased through protection of industries.

These necessary results can be attained by the adoption and enforcement of a reasonable, balanced policy, firmly predicated upon sound economic principles such as has been adopted by the Sanitary Water Board of Pennsylvania.

Let us consider the history of the matter of discharge of coal mine drainage to streams in Pennsylvania.

In the well-known Sanderson case (Pennsylvania Coal Co. vs. Sanderson, 113 Pa. 126) the Supreme Court of Pennsylvania upheld the right of the coal company to discharge mine drainage to a stream the water of which lower down was used by a private riparian owner in a private fish pond on his property.

But on January 29, 1925, the Court of Common Pleas of Fayette County, Pennsylvania, issued an order, pursuant to the mandate of the Supreme Court, to certain defendant coal mine companies in the valley of Indian Creek, enjoining them after July 30, 1925, from discharging mine water into Indian Creek above the dam of the Mountain Water Supply Company, which is the source of public water supply of about 75,000 people and also is used for steam raising purposes in railroad locomotives.

Pursuant to application made to the governor, presumably to carry out the above court order, a charter was granted on February 15, 1926, to the "Indian Creek Valley Mine Drainage Company" to facilitate the construction of an extensive system of conduits whereby the mine drainage of at least four of the largest defendant companies may be intercepted and discharged below the water-works intake of the plaintiff.

On March 9, 1926, the Fayette County Court declared 22 of the defendant coal companies in contempt of court, required them to seal their mines within 30 days, and provided for the sheriff to so do if the companies fail to comply.

These conditions are the result of lengthy litigation inaugurated by the water company and in which the commonwealth participated because of the public use of the water supply, which was threatened by the discharge of the mine drainage.

This case was carried to the Supreme Court of Pennsylvania, and in its decision this court said: "Our conclusion is that defendants have no right of any kind to drain their mine water into the stream, considering the public use which is made of its waters, and that their so doing constituted a nuisance which must be restrained."

As about 100 public water supplies in Pennsylvania are more or less affected by coal mine drainage, it becomes apparent how important this decision of the Supreme Court is to the coal mining industry of Pennsylvania.

It should be borne in mind that these court orders are the termination of years of litigation, during which plaintiffs and defendants must have expended very large sums of money in the employment of attorneys, engineers, chemists, etc.

Now the defendant coal companies in the Indian Creek Valley, who will continue to operate their mines, must spend more money to build and maintain the system of conduits, and the coal in the sealed up mines will remain in the ground unused and a financial loss to the owners.

However, it appears that there is another and a constructive way for industry to spend money in the matter of waste disposal, to wit, in cooperation with the state to determine reasonable and practicable ways and means for the treatment and disposal of industrial waste waters.

For example, in 1924 an agreement was executed by the Sanitary Water Board of Pennsylvania with practically all the leather tanning companies operating tanneries which discharge wastes to the streams of Pennsylvania. This agreement provides for the creation of a fund of $35,000 to be conrtibuted by the participating companies in proportion to their capacity to tan hides and also for financial and technical participation by the board.

The fund is being expended by a committee, created by the agreement, consisting of three chief engineers and three chief chemists of the tanning companies and the chief engineer of the Sanitary Water Board as chairman.

The work of the committee chiefly consists of three main investigations:

(1) Research in the laboratory.

(2) Actual operation of a full-scale experimental tannery waste treatment works.

(3) Observations of the streams below the works to determine the assimilating power of the stream to receive untreated tannery waste and also of the effluent of the treatment works after various degrees of purification.

Investigations have shown that the pollution load of the various tanneries varies from a ratio of 3.8 pounds of hides a day per cubic foot per second of ordinary stream flow in the case of a small tannery situated on a large river up to a ratio of 360,000 pounds per second foot during drought flow in the case of a tannery unfortunately located on a small stream.

The range of degree of treatment to permit inoffensive assimilation of the tannery waste will, therefore, probably vary from none at all where there is ample diluting water available to inoffensively assimilate the wastes up to, in a few instances, almost complete purification.

The agreement provides that if "reasonable and practicable" means of treatment and disposal are found by the committee and approved by the board the installation thereof at any tannery will be deemed compliance with the laws.

In 1925 the Sanitary Water Board invited and promptly obtained cooperation with the pulp and paper industry of Pennsylvania and again a technical committee representing that industry was formed similar to the tannery committee.

In this industry a somewhat different condition exists. Most pulp and paper mills have already installed devices for preventing the discharge of a large percentage of wood pulp fibers formerly wasted to the streams and also for other waste substances such as result from the soda process of pulp manufacture.

But still there are wastes for which no practicable means of treatment are now known, such as sulphite pulp liquor. The committee set these facts forth in a report wherein it was recommended that efforts to solve these unknown problems be made on a nation-wide basis.

As cooperative relations have recently been established in Ohio and Wisconsin between the state and the pulp and paper industry, and as the principle of cooperation with industry was indorsed by officials of several other states, the nation-wide scheme was submitted to and approved by the Technical Association of the Pulp and Paper Industry and the American Paper and Pulp Association at their annual meetings last February in New York.

The result is that there has been created by the American Paper and Pulp Association a "National Stream Purification Committee for the Pulp and Paper Industry," which will act as an advisory body in connection with the forthcoming studies on waste disposal.

This committe consists of representatives of pulp and paper mills in Pennsylvania, Wisconsin, Ohio, Michigan, Maine, and Massachusetts, the secretary of the Technical Association of the Pulp and Paper Industry, and the chief engineers of the Health Departments of Maryland, Michigan, Ohio, Pennsylvania, and Wisconsin.

Why have these two great industries thus cooperated with the Sanitary Water Board of Pennsylvania? Something must have happened to change the industrial antagonism and indifference of past years into the present cooperation with the states. The answer is clear and definite—a recognition on the part of certain state officials of the need for adopting and announcing practicable and workable policies for administration of the anti-stream pollution statutes.

The fundamental policy of the Sanitary Water Board is given in the following resolution providing for the classification of streams:

CLASSIFICATION OF STREAMS

WHEREAS the degree of pollution of the waters of the state varies widely from the pristine purity of a small stream flowing through a virgin forest to the grossly polluted stream draining a valley given over to intense municipal and industrial development; and

WHEREAS such differences in condition and the present and probable future use of the streams must be recognized in determining the required degree of treatment of sewage and industrial wastes; and

WHEREAS the natural power of streams to inoffensively assimilate and dispose of polluting matters by dilution must be utilized so far as compatible with the general interests of the public in order to establish a practicable and economical program for stream control: Therefore

Resolved, That the waters of the state be classified as follows:

RELATIVELY CLEAN AND PURE STREAMS

Class "A"

Streams in their natural state probably subject to chance contamination by human beings but unpolluted or uncontaminated from any artificial source, hence generally fit for domestic water supply after chlorination, will support fish life and may be safely used for recreational purposes.

STREAMS IN WHICH POLLUTION SHALL BE CONTROLLED

Class "B"

Streams more or less polluted, where the extent of regulation, control, or elimination of pollution will be determined by a consideration of: (a) The present and probable future use and condition of the stream; (b) the practicability of remedial measures for abatement of pollution; and (c) the general interests of the public through the protection of the public health, the health of animals, fish, and aquatic life, and the use of the stream for recreational purposes.

Class "C"

Streams now so polluted that they can not be used as sources of public water supplies, will not support fish life, and are not used for recreational purposes, and also from the standpoint of the public interests and practicability it is not now necessary, economical or advisable to attempt to restore them to a clean condition; and further

Resolved, That all artificial pollution of Class "A" streams shall be prohibited, and any sewage or industrial wastes on the watersheds shall be treated to such a degree that the effluent shall be practically free from suspended matter, nonputrescent and disinfected, and that recreational use shall not be sanctioned within prejudicial influence of waterworks' intakes; and further

Resolved, That the degree of treatment of sewage and industrial wastes discharged into Class "B" streams shall be determined for each particular stream or portion thereof after consideration of the general interests of the public and the economies of the particular case; and further

Resolved, That sewage and industrial wastes may be discharged into Class "C" streams; provided, however, that such discharge shall not create any public nuisance or menace to health.

This resolution commits the board to do all that lies within its powers to preserve the now wholly unpolluted Class "A" streams in their present clean and wholesome condition.

It recognized that some streams, such as the Lackawanna River, which drains the anthracite coal region of Pennsylvania, can at present apparently best be utilized for disposal of mine drainage and municipal sewage.

Due to the germicidal action of coal mine drainage present in the Lackawanna River, the sewage of a population of about 320,000 is being inoffensively assimilated by that river without any treatment. Hence enormous sums of money are being saved the coal companies and the municipalities by utilizing this river for waste disposal.

The majority of the streams of the state, however, will fall into Class "B," and note the criterion erected for determining the degree of treatment, if any, of polluting matter discharged to such streams, viz, the use and condition of the stream, the practicability of remedial measures, and the economies of the case.

The board has also erected an order of precedence of use of water resources in order to apply the above principles. The highest use of water resources is:

(a) For source of supply for waterworks serving the public for domestic and municipal purposes.

Thereafter the utilization of water resources, generally, but not always, applicable in every specific case consists of—

(b) For purposes of sanitation by the conveyance of sewage and industrial wastes after suitable treatment when and where needed.

(c) For water for manufacturing and industrial purposes and for development of power and agriculture.

(d) For navigation.

This is a decided and radical departure from the policies of some administrators of anti-pollution statutes who have tried to maintain the position that all pollution must cease regardless of the use and condition of the stream and the economies of the case.

How can the above new principles be applied to the coal-mining industry?

Is it not obvious that the best interests of the public in certain cases will justify the setting aside of certain streams draining coal-mining regions for the avowed purpose of affording a convenient, reasonable, and economical method of disposal of coal mine drainage?

Is it not equally obvious that where coal mine drainage menaces an important public water supply that reasonable and practicable treatment of the mine drainage is more to the public interests than for the coal to lie idle in the ground?

Will it not be to the interest of the coal-mining industry of the United States to solve these problems in cooperation (*Continued on page* 469)

PROGRESS IN LOADING COAL MECHANICALLY

With But Four Percent Of The Bituminous Coal Mines Mechanized Interest Centered Strongly About The Sessions Devoted To Mechanical Loading At The Cincinnati Convention—Papers Presented Show Rapidly Increasing Interest In Mechanization

THREE sessions of the Annual Convention of practical coal operating officials, held at Cincinnati, Ohio, during the week of May 24, were devoted to discussion of mechanical loading problems. At the Wednesday morning session, May 26, Eugene McAuliffe, President of the Union Pacific Coal Co., presided. This session was divided into four major sections, covering: "Mechanical Loaders that have operated sucessfully at the face and their operating costs"; "Shaking Conveyor Loader and its use in mining coal"; "Methods of adapting present standard mining systems for best results with Mechanical Loading"; and "Getting Mine Cars to and from Mechanical Loaders." James Elwood Jones, President of the Pocahontas Fuel Co., presided at the Wednesday afternoon session, which included discussion of the following subjects: "Methods for Mining Thin, Flat Seams with Mechanical Equipment"; "Mechanical Loaders in Pillar Work"; "Mechanical Loading in Rooms and Entries"; and "Mechanical Loading of Top and Bottom Rock Entries." A. C. Callen, University of Illinois, presided at the Thursday morning session, when "Underground Conveyors" was the topic for discussion. Papers were presented on: "Inside Mine Conveyors"; "Room and Pillar Mining with Conveyors"; and "Mining Plans for Different Types of Conveyors."


EUGENE McAULIFFE
UNION PACIFIC COAL CO.

EUGENE McAULIFFE, *President, Union Pacific Coal Co.*, in opening the discussions on this subject said:

"I am very much impressed with the group here this morning. It proves the interest in the mechanization of our bituminous mines. At the meeting a year ago there was a considerable note of optimism expressed as to the possibilities of mechanization. Since that time the coal industry has got into a rather worse business condition. At least it has not improved. This fact suggests more urgent necessity for the adoption of any method or theory which will tend to improve the business situation and stabilize and compose the industry. Perhaps some of us have been influenced by the unfortunate developments that have taken place in England and Scotland.

"Now as to the success of mechanization. I want to repeat what I have said before several times—that in my humble opinion the problem is 90 percent management. Where management will take hold and decide to go ahead and succeed regardless of any temporary disabilities that may develop, and providing reasonable judgment is exercised in the type of machinery and method of application, it can be made to go.

"The problem of cleaning is of course, a substantial one, but we will solve that problem as it arises.

"I am not fearful of opposition from labor either unionized or non-unionized. I think that our labor very largely gets its theories from the mine management and that includes everybody from the President, if they have one, down to the assistant boss or job driver. It has been my experience that men in every walk of life are willing to go along providing they can get somebody to set the pace. We will have to disregard a tremendous amount of tradition. Mechanization means the abandonment of a great many old methods. We will practically have to reconstruct many of our mining laws and perhaps many of our wage scales. But all we have to do, and I think we have genius enough in the industry to do it, is to apply ourselves to these problems and they can be worked out. Go back 25 years to the problems that confronted various industries including that tremendous industry, transportation. Theories of management and mechanization were advanced that seemed almost futile. Every step was marked with a failure. Today they have been made more than a complete success, they are absolute necessities. The inventive genius of our engineers have worked out all of the difficulties and the scheme today is a perfect one and one that has become indispensable to us."

MECHANICAL LOADERS THAT HAVE OPERATED SUCCESSFULLY AT THE FACE AND THEIR OPERATING COSTS

This subject was to have been presented by A. W. Dickinson, General Superintendent, Union Pacific Coal Co., Rock Springs, Wyo. However, Mr. Dickinson was unable to attend and G. B. Pryde, Vice President and General Manager of the company presented the subject for him.

GEORGE B. PRYDE, *Vice President and General Manager, Union Pacific Coal Co.:*

"We have 17 operating mines in Wyoming. During the year 1916 we installed, at one of the Hanna mines, a Thew electrically equipped loader. Since that time and at varying times we have installed three more. We have also at that particular mine 12 Joy 4 BU's in operation. In Rock Springs at one of the mines, we have a Goodman Scraper Loader which has been operating now for about three months and at the same mine we have two Eickhoff conveyors working. At the Superior mines we have three conveyors of the Eickhoff type. That constitutes at the present time our loading equipment, although we plant further installations of scraper loaders in the very near future.

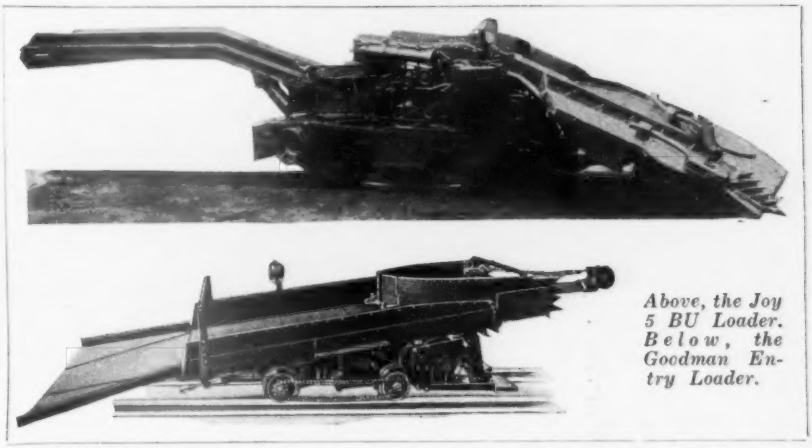
"We have had remarkable success with the Eickhoffs. Our development work had become a problem and since putting in these Eickhoffs we feel that we have solved to a large extent the problem in driving in our work. Before buying this scraper loader, we built a home-made loader consisting of two hoists and a scraper that we fabricated in our own shops. It was rather a crude affair, as all home-made devices are, but we sought first to get information on the rough control which was very necessary in long face work. After seven months operation with this old machine we decided to buy the scraper loader unit that we now have in operation. With the home-made scraper we mined about 20,000 tons of coal in mining out a block 300 feet long and 500 feet wide. We were able to control the works very well. Our original plan was to take out this block of coal in long face and cave behind us. With the original machine we installed we found that the roof would not always cave to suit our working cycle. We are at present mining what we call a block system. We have mined out two blocks and are now working on the third. The first block we mined contained 10,000 tons of coal. We were rather unfortunate in this respect, for at the close of a week we had shut the face, and on Monday morning

it had caved completely and we had lost all the coal and timber. On the second block we were quite successful. We got about 11,000 tons out of that block. It caved, but we recovered about 90 percent of the timber, and that is quite an item. These timbers cost about $1.00 each, plus the labor of taking them into the mine.

"The scraper unit hauls about 3½ tons per trip load of 28 cars and we have a drum hoist which stands at right angle to the working face. We haul the coal with a scraper into the conveyors and then into pit cars. This operation is quite successful. When we get the other scraper installations we plan to go back again to the long face and cave the gob behind us.

"At the Hanna mines we have rather unusual conditions. We have 35-ft. seams of coal on a 16 degree dip. We started first to take out with hand loaders 8 ft. of coal. Then we shot down 19 ft. of coal and loaded with the Thew loaders. During the last two years we have installed 12 Joy 4 BU's which are quite successful. Of course all 12 are not running all the time. We keep one machine in the shop all of the time, repairing it. The objection to the hand loading principles was the slow rate of advance. With hand loaders we advance 1 ft. per day and with Joy loaders 7 ft. per day.

"As to the cost, that is a very difficult thing to determine. In some of the newer installations particularly it is very hard to get an accurate estimate of the cost. The scraper loader is saving money, probably about 40c per ton, and that is true of the Eickhoff. The Joys have not made so very much money but that is not the fault of the machine. Formerly we did all the driving of narrow work with machines and hand loaders, but now the Joys do that work and they ought to have a certain amount of credit for that. The Thew machines load about 75 tons per day and the Joys load about 100 tons per day. With the scraper loader during the month of April and for several days in March, or 32 consecutive working days, we loaded 346 tons per shift with a crew of 15 men including the foreman. We pay all of the men working around the loader $7.92 per day. That is the scale for eight hours work in Wyoming and the machine runner gets $8.30 per day. We find by making careful time studies on all of our loading equipment that there is a very large percentage of administrative delays. During March, our administrative delays were approximately 60 percent and delays on account of repairs 40 percent, so our job, we feel to be, is cutting down those administrative delays. We feel we have accomplished some things with mechanical loading but also we feel we have a long way to go."



Above, the Joy 5 BU Loader. Below, the Goodman Entry Loader.

Discussion:

MR. MCAULIFFE:

"I said in the beginning that it was necessary to sell the theory of mechanization. Our people have bought it. As a matter of fact we have developed a substantial amount of rivalry between the superintendents in the different districts. They want novelties.

"Mr. Pryde has spoken of administrative losses. They exist through the coal mining industry everywhere. We put an engineer on the job of measuring them, and in June, when the engineering colleges close we will get three or four young men to make time studies for this engineer.

"Our people want mechanical loaders, and our men are not very far behind."

The general discussion following Mr. Pryde's paper brought out the fact that the seam these loaders are working in is 12 ft. in thickness, the height of the coal being abnormal, running about 7 ft. It also brought out the fact that approximately four hours of each day is lost due to delays which occur principally in moving, and also because the coal has no cleavage which makes it necessary to take jack hammer drills and break the chunks before the machines can load them. The Joy machines during their first year loaded 100 tons per day, but are now loading 90 tons per day, due to the fact that they are used in driving the room necks, cross cuts and entries. The Union Pacific Coal Co. is probably the only company in the world that has ever kept 12 loaders in operation. They have done this at a cost of about 8c per ton, which they believe is due to good organization and a determination to succeed.

SHAKING CONVEYOR LOADER AND ITS USE IN MINING COAL

H. F. McCULLOUGH, Engineer, H. C. Frick Coke Co., Scottdale, Pa.:

"There are now available a number of different types of mechanically satisfactory and substantial loading machines which will load coal at rates varying from one to four tons per minute. The problem is, first, to take the coal away from the loading machines as fast as they can pick it up; and, second, to provide them continuously with a supply of suitably prepared coal ready to load out.

"It is now generally recognized that any arrangement which involves the bringing up and removal of one mine wagon at a time to the loading machine will not permit anything like a realization of the full capacity of the loading machines. Some mode of transportation other than mine car haulage must be resorted to.

"Conveyors are the solution of the first problem, that of taking the coal away from the loading machines as fast as they can load it.

"Many types of conveyors have been proposed and used for this purpose. Each type is or can be made to satisfactorily perform the service required.

"While considering the shaker conveyor for this service, it was recalled that if the forward end of such a conveyor was lowered to the floor level, the oscillating or back and forward movement of the conveyor imparted a shovel-like action to the forward end and that such material as was within the range of its movement would be picked up and forced into and along the shaker conveyor troughs. When the material within the range of the oscillating movement of the forward end of the conveyor was disposed of, the shoveling action, of course, ceased. One manufacturer of these shaker conveyors provided a telescoping section for the forward end of the conveyor, arranged so that when the material within range had been disposed of, the conveyor would be stopped, the bolts holding the two telescoping troughs composing the front section removed, the section extended, the bolts replaced, and the conveyor again started to work at loading out the coal within the range of the new setting.

"It was evident that the shaker conveyor thus used constituted a combined

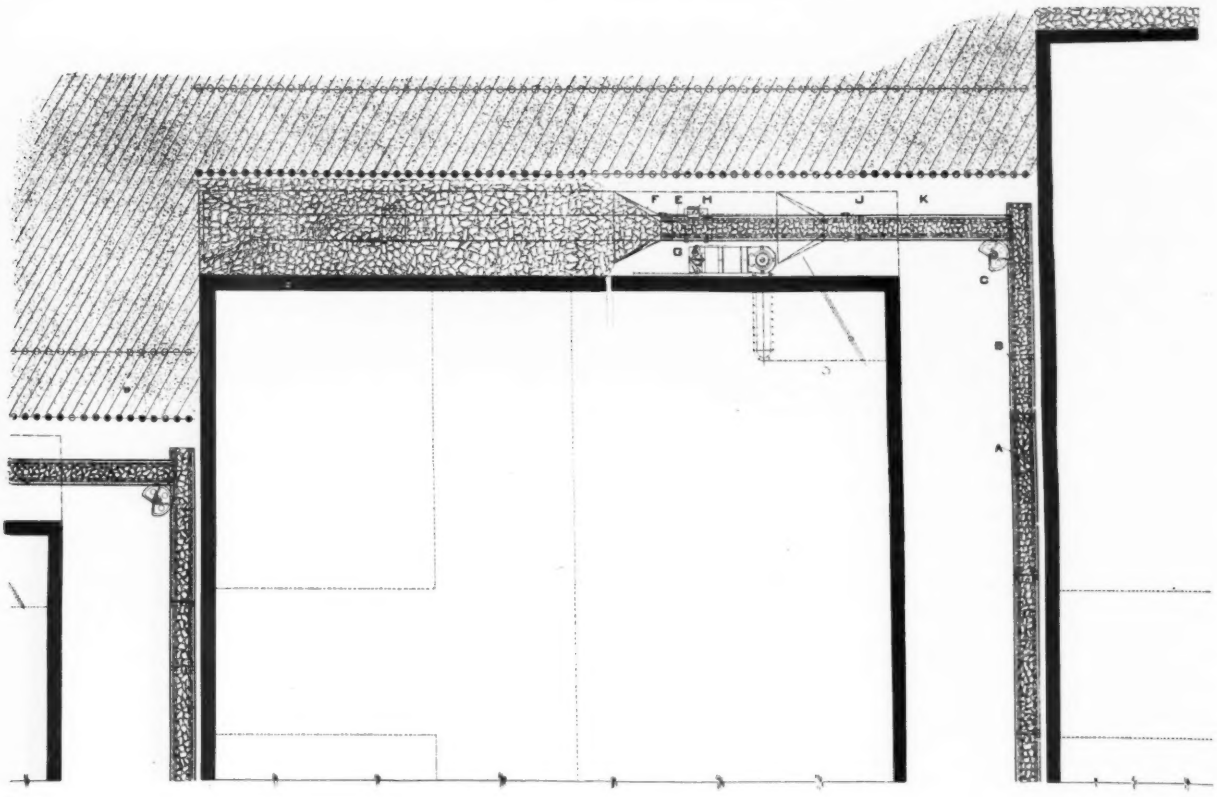


Fig. 1, *Mr. McCullough's Paper*

loader and conveyor insofar as concerned the material lying within the range of movement of any particular setting, but it was also evident that this was the limit of the exercise of its dual function, and to again bring it into play as a loader, that the conveyor would have to be stopped, the telescoping sections unbolted, the forward end forced forward into new material, and then bolted up again. This was not mechanical loading, but it was, of course, evident that if some form of automatic feed were provided for the telescoping forward section there would result a combined loader and conveyor of extreme simplicity and effectiveness.

"On paper it looked as though we had in this mechanism, which we have christened the shaker-conveyor-loader, something deserving of development and steps were then taken to determine where and how it could be applied.

"In the driving of headings it was evident that, where shooting on the working shifts was permitted, with undercutting and drilling equipment localized in the place and with this shaker-conveyor-loader, that a continuous cycle of undercutting, drilling, shooting and loading operations could be carried on, and that more efficient work and faster progress would be the result.

"Such an arrangement as the shaker-conveyor-loader solves the problem of taking the coal away as fast as it can be loaded out, but not the problem of providing it continuously with a supply of suitably prepared coal ready to load out. Only as much coal as was thrown by one cut in the comparatively narrow room or heading was available at any one time.

"Further consideration led to the idea of applying this mechanism to the loading out of longface coal. By the means now to be described the coal cannot only be taken away as fast as it can be loaded on long-faces, but a large supply of suitably prepared coal ready to load out can be kept continuously available for the shaker-conveyor-loader to work on.

"Where wide headings are driven, a separate shaker-conveyor-loader unit complete with driving engine can be used for the face loading operation and arranged to discharge its coal onto the heading conveyor.

"With narrow headings and restricted space generally the shaker-conveyor-loader for the long-face can be driven by the heading shaker conveyor by transmitting the oscillating motion of the heading conveyor to the shaker-conveyor-loader along the face by means of a bell-crank or a pair of rope segments as shown in Fig. 1.

"Fig. 1 shows the detail arrangements for this method of procedure. (A) is the end of the heading shaker conveyor which was placed while the heading was being driven. Onto the end of the heading conveyor is placed the extension trough (B). This is used so that a fixed relation may be maintained between the drive gear (C) and the end troughs of both heading and face conveyors, the drive gear being connected in to both end troughs so as to impart the oscillating motion of the heading conveyor troughs to those composing the face conveyor.

"The shaker-conveyor-loader proper consists simply of a section of conveyor trough (E), with or without a widened shovel and (F), and another section of trough (G) meshed in or nested with it. The automatic feed device (H) serves either to maintain a fixed relation between (E) and (G), or to advance (E) and (F) forward or backward with relation to (G).

"At the start of loading operations the trough (G) is positioned at the forward limit of its travel range along trough (E); trough (E) is placed on and nested with the first face conveyor trough (K) so that the rear end of trough (G) meets the forward end of trough (K). Troughs (G) and (K) are connected, the conveyor is started and the shovel end is started into the pile of shot-down coal by throwing the automatic feed into action. This forward

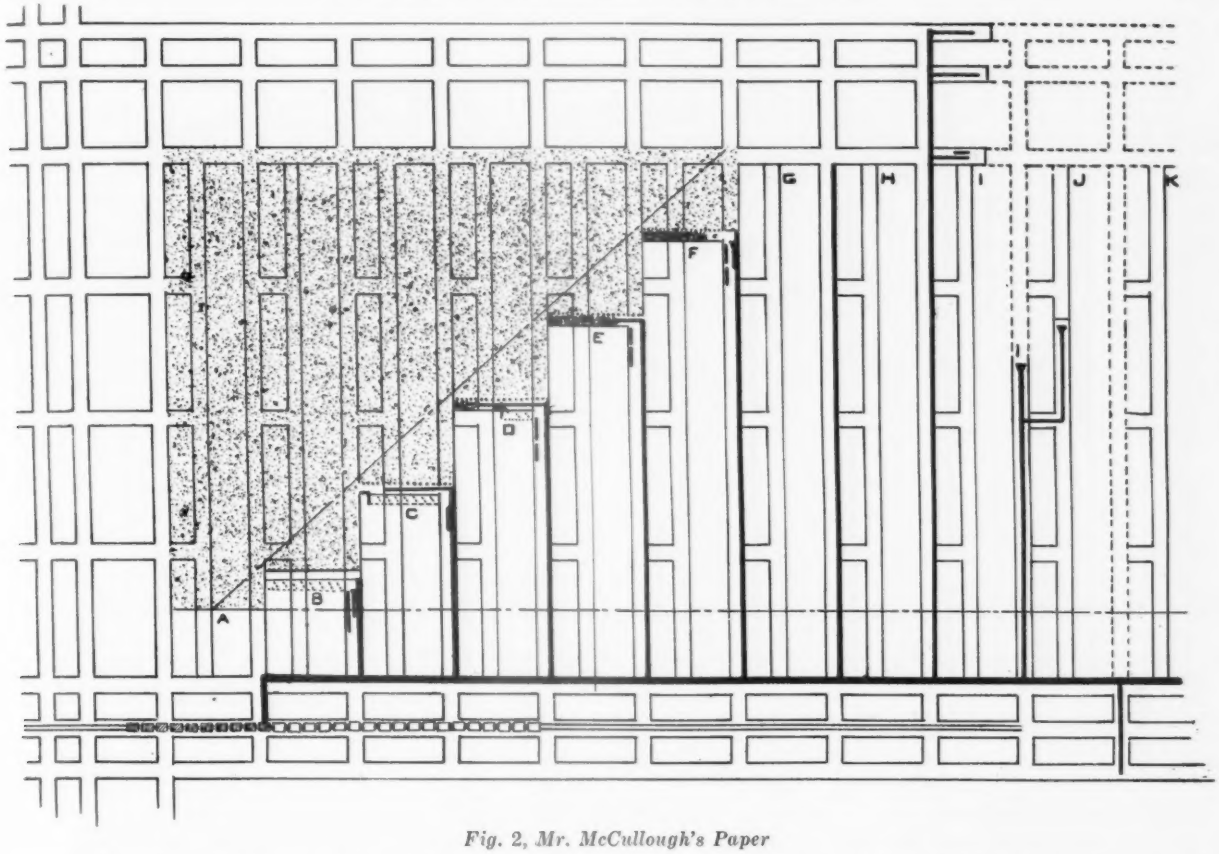


Fig. 2, Mr. McCullough's Paper

movement can be continued at any desired rate of speed until it equals the length of one conveyor trough. The connection between troughs (G) and (K) is then broken, trough (G) again moved forward on trough (E) to the limit of its travel thereon, a second trough (J) put in place and connections made, the conveyor started and the forward movement into the shot-down coal continued.

"The difficulty with most longface loading schemes has been that they were too complicated to be practical or that the space required at the working faces exceeded that which could be kept open under the roof conditions that prevailed. It is difficult to conceive any loading device more simple than the shaker-conveyor-loader, and with this scheme of long-face loading the span of roof to be maintained at the working faces is reduced to the absolute minimum. It need only be equal to the depth of the undercut. Furthermore, additional rows of timber may be set between the break row and the face. The only thing to be cleared is the conveyor, which is ordinarily about 2 ft. wide.

"One plan of procedure for long-face loading with the shaker-conveyor-loader is shown by Fig. 2, and may be described as follows:

"This shows a panel of long-faces so arranged that five faces are being worked upon at all times and the development work necessary to keep pace is carried on simultaneously.

"Face (F) is shown in the first stage. The face of coal has been shot down and is ready to be loaded out. The undercutting machine and the conveyor pans needed along the face are stabled in the heading as shown. The coal at (a) is shovelled directly onto the heading conveyor and space thus cleared for the automatic feed telescoping conveyor trough section which constitutes the shaker-conveyor-loader. The driving gear is placed and coupled into the junction troughs and the loading out operation is ready to start.

"Face (E) is shown in the second stage. The shaker-conveyor-loader is in place and ready to operate. Operation is commenced by starting the forward end of the shaker-conveyor-loader into the pile of shot-down coal by throwing the automatic feed into action.

"Face (D) is shown in the third stage. As soon as the first part of the face has been loaded out the undercutting machine can start making the next undercut, the scraper can throw the cuttings directly onto the conveyor, and the shot holes may be drilled, charged and tamped. By this mode of working all the preparatory work for the next face of coal can be completed shortly after the loading out of the preceding cut is completed, as illustrated by Face (C). As soon as the new line of props is set the face may be shot and the loading out of it proceeded with. Practically continuous operation is thus made possible.

"Face (C) is shown in the fourth stage. All of the shot-down coal is loaded out and the shaker-conveyor-loader has been removed from the face and stabled in the heading. Beginning at the forward end each section of trough is disconnected and dragged over the sections yet in place to the heading and stowed as shown. Successive sections are likewise handled until the whole conveyor has been removed from the face and stowed ready for another loading cycle. When the undercutting is completed the cutting machine is also brought back to the heading.

"Face (B) is shown in the fifth stage. As soon as the conveyor is removed from the face, it having been previously undercut and drilled, as above described, the placing of the new line of timber may be started from the center and carried on towards the ends of the face. When a portion of the new line of timber is set, the drawing of the old line can commence and hence completed shortly after the new line is all set. The face is then shot and is again ready for loading out.

"Face (A) has been drawn back to the barrier pillar line and the equipment removed.

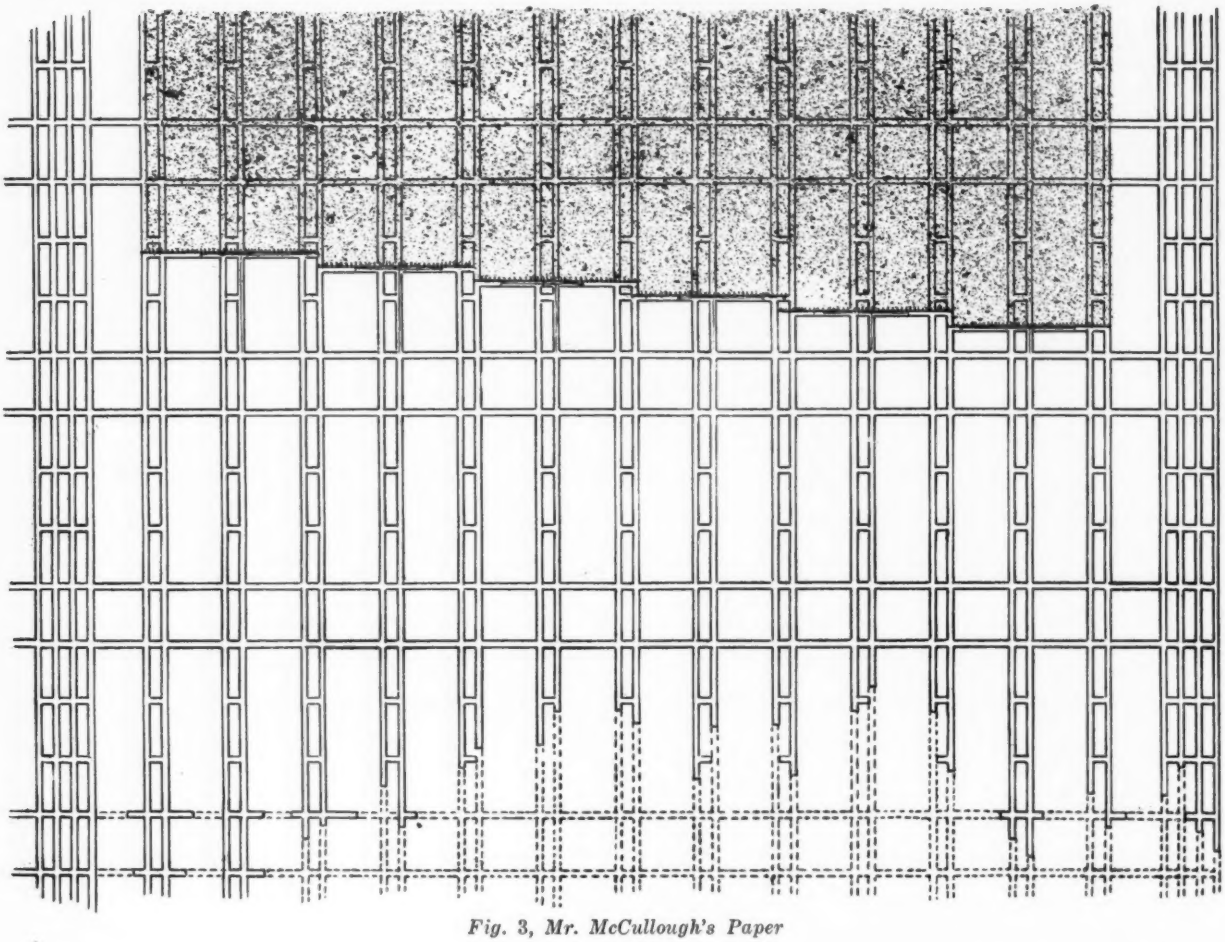


Fig. 3, Mr. McCullough's Paper

"Face (G) is completely developed and ready to be worked back. As soon as face (B) is back to the barrier pillar line, the equipment in use on it will be moved to face (G). Face (H) is completely developed except for the short lengths of barrier and air-course headings in which working is shown as still going on. Such parts of the conveyors placed for the handling of the coal from the development headings as are needed for the conveying of the face coal are left in place, as shown in the case of face (G). The development for face (I) is shown only partly completed. Here also is shown the method used when double headings are used.

"Fig. 3 shows a proposed continuous panel system of long-face working wherein development work is kept at the minimum distance in advance of the second working.

"By using the shaker-conveyor-loader and keeping an undercutting machine in each working place of the development work, a rapid rate of progress can be maintained and the area under development correspondingly reduced.

"Experiment with this idea of a shaker-conveyor-loader and the idea of applying it to the loading out of long-face coal has progressed far enough to justify the assertion that the ideas are practical and generally applicable to the mining of coal and other materials. The automatically advancing trough will load coal up to the limit of the conveyor to carry it away. The conveyor will carry the maximum amount of coal because the device can be continually kept headed into coal ready to load out, and can be fed into the coal at a rate which will develop the full capacity of the conveyor. What is needed is further development to adapt it to the various conditions and arrangements that will be encountered.

"While discussing this scheme of a shaker-conveyor-loader and its application to the scheme of long-face working, above described, with Mr. Eugene McAuliffe, president of the Union Pacific Coal Co., he informed me that he had just installed some shaker conveyors in the mines of his company for use in conveying the coal away from the advancing ends of development headings and that they were attempting to work out an automatic feed device for the forward end of the conveyor so as to facilitate the loading out of the coal. Several members of the Union Pacific Coal Co. staff had ideas as to the form of feed device needed and they have developed these into satisfactory mechanisms one of which is shown at (H) in Fig. 1.

"Having gone this far with the idea, they decided to try out the long-face loading scheme above described. They have put this into operation and I expect that Messrs. McAuliffe, Pryde and Dickinson of the Union Pacific Coal Co. will tell of the results so far attained in the application of the idea."

Discussion:

MR. PRYDE:

"As I said before, we have five Eickhoff Conveyors working. Heretofore we have worked them and our rate of advance had been very good. One day when we were in a hurry to get a place through for the scraper loader we drove a single place 12 ft. wide and 6½ ft. high in 9 hours, and nearly every day we get three machine cuts, 15 tons to the cut, with a crew of three men, two men at the face and one man on the entry loading.

"One of our superintendents, Mr. McCarty, has developed an automatic feed for the Eickhoff, both for the narrow work and in the long face work. A week ago I saw this automatic device

eat into the coal—amounting to 15 tons in 16 minutes in the long face. We plan to adopt this automatic feed on the long faces as shown by figure (2) on Mr. McCullough's print. We were not successful in controlling the roof on this long face, so we have decided to go to the step face 100 ft. in width as shown by Mr. McCullough's print. We expect to be able to control the roof with this system. We feel that we cannot make any money shoveling coal on the conveyor with hand shovels. We shall have to develop some system of automatic feed on these long faces, cutting down the number of men shoveling. It will be necessary of course in starting the conveyor to shovel for about 13 ft. so as to get the conveyor started, but after that the remainder ought to be pretty well loaded with the automatic loader. One day, a week ago, we loaded 160 tons on a long face in 8 hours. We have sandrock intrusions in our coal which interfere somewhat on the long faces with the successful operation of the Eickhoff conveyors on the long face, because we have to dig them out. Another thing about this automatic feed, we take the bug dust and spread it on the floor before shooting and this allows this large shovel arrangement, which represents the end of the Eickhoff unit, to undermine the coal and the larger chunks fall on to the conveyor. The original width of the duck bill that Mr. McCarty designed was about 4 ft."

MR. R. Y. WILLIAMS:

"The thing that I like about Mr. McCullough's paper is that in his long face mining he is able to reduce the amount of the over-hanging of the lever from the long face by the width that he had to keep open for the ordinary type of conveyor. In other words, I think that our main success in long face mining is going to be when we get away from the necessity of worrying about the beam of the roof that is supported mainly by projected pillars and come to the true long wall face which is long enough to give you real long wall action, which is a kind of lever functioning directly on the face of the coal.

"Now the question is to be able to move that out far enough to enable the men to work safely. The scheme for providing that safety is with a rigid metal fabricated jack and we have had very good success, but any new scheme has to have its kinks taken out, and consequently we don't feel that we are ready to tell the details until we have gone far enough with it to be sure of them. The area in the mine where we were trying these metal jacks was very limited. We were able to operate two 200-ft. faces and take them for a distance of 200 ft. and 350 ft., respectively. We waited for nine months while we were developing a new mine next door. This mine is to have three 300-ft. faces, one of which has been going since the 21st of April. On the two tests and on the new 300-ft. face, we were able to get a major break after we had gone 85 ft. After the major break we got a roof fall behind the jacks every day without shooting and strangely enough the same men are today working on the 300-ft. face that started the first of the 200-ft. faces, and we have a waiting list for both the second and third 300-ft. faces when they come in. That will be within the next two months. We are using on the present face a Jeffrey Conveyor, 300 ft. long. On the second one we are going to try the Eickhoff and as a result of the convention here I am inclined to think we will try the Eickhoff with the duck bill. It looks very feasible."

In the discussion which followed it was brought out that the duck bill will load up to six tons per minute, and that the Union Pacific Co., has loaded two tons per minute with it. The Eickhoff conveyor will lift coal up a 7 percent grade.

METHODS OF ADAPTING PRESENT STANDARD MINING SYSTEMS FOR BEST RESULTS WITH MECHANICAL LOADING

W. L. McCOY, Mine Inspector, Bertha Consumers Co., Pittsburgh, Pa.:

"The two most important factors governing mechanical loading that cannot be changed are: First, the nature of the coal and second, the roof and bottom. Under our first caption—the nature of the coal, we must consider what is commonly known as a free shooting coal or one that can be blasted in such shape that it makes it an easy matter for the loading machine of whatever type used to handle the product and at the same time produce a marketable domestic product. Next, the coal must be free from excessive impurities for the above reason, a marketable domestic product.

"Under the nature of roof and bottom we have two sub-divisions, first the roof must be reasonably hard to eliminate extensive timbering, second the bottom must be hard to prevent the mixture of dirt with the face coal.

"Other important operating factors to be considered are:

"(A) Electrically operated mechanical loaders should not be used in gaseous and dusty conditions. Where dry and dusty coal conditions exist, the proper preparation for mechanical loading is to use a spray of water on the cutter bar of the mining machine, thereby eliminating the greatest source of coal dust in suspension caused by the handling of the bug dust or fine cuttings made by the mining machines.

"A motor may be gas proof and permissible type, but due to the possibility of cable failure would be hazardous to operate where the above conditions obtain.

"(B) Ventilation must be properly conducted through the loading section and should be so arranged that it will sweep the working face.

"(C) Haulage must be carefully planned to obtain maximum efficiency of the machine. With due respect to the manufacturer he quite frequently cites haulage defect as the direct cause of the failure of the machine to function properly. This is determined on by your local conditions.

"(D) Power lines should be of ample capacity to meet extreme requirements and insure economic and efficient operation of the machine.

"I have taken the Pittsburgh seam because I am more familiar with the conditions existing in that particular seam.

"(E) Projection or lay-out of a mine for a room and pillar system in the Pittsburgh seam of coal should incorporate: First, 40-ft. room centers. Second, rooms driven 24 ft. wide on advance, which in 7-ft. coal and 6-ft. undercut, will produce approximately 40 tons. Third, there should be at least six of these rooms to a machine section to produce a daily average of 160 to 175 tons, which is, I believe, a pretty fair production from a loading machine. Fourth, room break-throughs should be driven wide enough to expedite the movement of a demountable wheel and tractor type loader, and eliminate the necessity of re-wheeling and tramming by rail from place to place, thus saving time and reducing actual operating delays. Fifth, the timbering is another factor to be considered—to insure safety to the operators of the machine and protection of the latter; to reduce to a minimum, inconvenience in the efficient operation of the machine. Sixth, retreat or pillar work: The capacity is governed by purely local conditions; the 16-ft. rib on 160-ft. room can be cut over at rib on 160-ft. room can be cut over at far as the roof conditions will permit. It may be possible to modify the loader method and combine it with hand loading, which we have found to be most practicable and economical for complete recovery. It is really more economical to draw all stumps and shell pillars by hand.

"Now in recapitulating these remarks, let me say first that in this discussion the system adopted has been that of room and pillar; second, mechanical loading theoretically is very efficient under normal conditions. In actual practice, the theoretical efficiency is reduced:

"A. By natural conditions beyond the control of man.

"B. Frequently by the mechanical defects in the design or construction of the machine, which is due to the designer's and manufacturer's lack of a thorough knowledge of all conditions under which his machine must operate.

"C. By failure to employ skilled operators and repairmen.

"D. By failure to study existing conditions and properly adapt the machine to the conditions.

"E. The tendency to consider the machine endowed with human intelligence with regard to the separation of impurities from the coal while loading.

"F. The frequent neglect of systematic timbering.

"G. By the lack of proper official supervision at the working face.

"It is a serious mistake to consider the installation of mechanical loaders for exclusive use on pillar work because the noise of the machine makes it practically impossible to hear the warning sounds (working of the roof and cracking of timber) that generally precede a rib fall, thus jeopardizing the lives of the men and safety of the machine. Another very potent factor is the necessity of properly shooting the coal and placing it in position for ease and efficiency in loading as well as effecting a fast and satisfactory cleanup for the cutting machine, with a minimum of hand labor.

"It may be said in conclusion that many installations of mechanical loaders are doomed to failure from the start, due to the mental attitude of the mine management, who too often assumes that he has solved all of his loading problems by the purchase of a mechanical loader and all that remains to be done is to provide the machine with a dinner pail and assign it to a working place in the mine."

Discussion:

STERLING L. LANIER, JR., *Norton Coal Mining Co., Nortonville, Ky.:*

"We have tried Goodman Scraper Loaders, and Joys and Jeffreys at various times and we have got pretty good results from all of them. In each instance we have made some saving. The vital thing is that the saving you accomplish is sufficient to justify the large investment of thoroughly equipping any mine of a reasonably large tonnage. On that point the main thing is—what is your wage scale? And is your wage scale going to decrease in the future. If it does your proportionate savings no doubt will be the same, but your dollars and cents are going way down, while the manufacturer has never been known to reduce the cost of his equipment. Most loading machines today cost ten or twelve thousand dollars. Those are the popular prices.

"We have achieved very satisfactory results with narrow work using the Jeffrey *Shortwaloader* in connection with the Jeffrey conveyors and I think where a new mine desires quick development you will make no mistake if you have sufficient head room to use those machines for narrow work. In a recent test covering a month's time, in which there were about 22 or 23 days of operating time, we, with one of these *Shortwaloaders*, drove a little over 600 ft. of entry, at a saving in cost of relatively, about 33 1/3 percent, on the hand loading method. This was very good and we are maintaining now an average of five and six falls a shift with this machine, averaging about 5 ft. to the fall. We use five men on that equipment. The width of the working place to get five or six cuts a day is about 15 or 16 tons to the fall. We loaded in that period something over 1,400 tons, getting a little over 100 falls. The 43-A *Shortwaloader* does not make as big lump coal as you would like to get if you have a commercial lump trade; however, it does not entirely break up the lump. We get a reasonable percentage of lump, but not as much as hand-loaded coal. We have a good hard bottom in this mine, but got equally good results in a soft bottom mine."

Jeffrey "Shortwaloader"

MR. EDWIN JOHNSON:

"Mr. McCoy mentioned several difficulties that stood in the way of the success of mechanical loaders. There are eight recognized defects in mechanical loading. One of these mechanical defects is squarely up to the manufacturer. Mr. Lanier mentioned a while ago popular priced machines. If we determine the price of the machine first and the quality afterwards we have gone at the thing backward. I believe there are no machines now that are in commercial use, as they are at present being built, that are not very much more able to stand up than they were a few years ago. Natural conditions no one has control over. Fitting the machines together is partly the fault of the manufacturer or the operator. That divides responsibility between those two. The other faults are not up to the manufacturer at all. Some are under control of the operator and are his responsibilities. In spite of those difficulties it is possible, as Mr. Lanier said, to make a saving of 25 or 30 percent. The question is, whether you can make savings with low rates of labor. This is amply answered with some of the Southern districts which have had marked success with mechanical loaders with the lowest wage scales. No one will doubt that reduction in the number of men employed under ground is in itself a safety feature which will result in fewer accidents."

GETTING MINE CARS TO AND FROM MECHANICAL LOADERS

CHAS. GOTTSCHALK, *Cons. Engr., Evansville, Ind.:*

"Serving the mechanical loader with empty mine cars at a rate which results in the minimum delay to the loader is a difficult problem for the principal reason that the rate of loading is seldom uniform.

"For instance, it is not unusual to observe a loader upon first entering a room or working place, to load out the first few cars at the rate of a ton a minute or better, but in the same room it may require 5 minutes, or 10 minutes, or even 15 minutes to load a car when the standing coal is being loaded out.

"I am referring to loading machines now employed in the Indiana and Illinois fields averaging according to conditions from 125 to 175 tons per shift. It is apparent that if the machines could load uniformly at the average rate of one ton per minute and do useful work 60 percent of the time, the output would be 288 tons per shift, and this is the approximate figure I predict will be accomplished by present machines when the problems involved are more generally understood.

"If coal is to be loaded at a uniform rate mechanically, the first problem is to bring the coal down in a free state, or employ a loading machine which is designed to mine as well as load, with or without blasting, as the case may be.

"Second, where mine cars are employed there should be a reservoir be-

tween the discharge of the loading machine and the car, so that car changes can be made without stopping the loading machine.

"Third, the maximum length of face should be prepared at each location that roof conditions will permit, so that the loader will have to make but few locations per shift.

"Fourth, each working place should be well lighted and ventilated.

"Fifth, the partings for accumulation of loads and supply of empty cars should be long enough and sufficient extra cars on hand to provide surplus to draw on when unavoidable delays do occur.

"Many other suggestions might be made, but I consider the above fundamentals.

"So while my subject deals with making car changes, the success of any plan that may be devised is so dependent upon the items just referred to, all contributing to loading at a uniform rate, that I cannot see how a balanced arrangement can result without their previous mastery.

"Not all operators look lightly upon the points just referred to, and the results they are obtaining are being reflected in larger and larger output per machine.

"I have referred to the desirability of getting a uniform flow of coal. Until this is accomplished within reasonable working limits, it is impossible to deal intelligently with the mechanics of car manipulation. For a practical demonstration of the need of a uniform rate of loading, if it requires two locomotives to serve a loader at re-occurring periods, and one motor is sufficient in alternating periods, the result is that about 50 percent of the time the investment in one locomotive and operator is a total loss. Also it becomes almost impossible to work out a main haulage schedule which will be efficient without demanding more idle cars for sidings than normally required.

"When these problems have been considered, and only then, will car changing efficiently be the main index of production per loader.

"Considering a case where these problems have been worked out with due regard to their importance, the problem of car changes becomes comparatively simple. In fact it almost vanishes. Under good conditions with no bad luck, around 290 tons have been loaded repeatedly. This would represent an average flow of coal of one ton per minute for approximately 60 percent of an eight-hour period. Leaving 192 minutes for car changes, moves, and delays. Provided the work is in rooms and pillars in 6 ft. coal and break throughs loaded out, probably six moves would be required. Time out for moves should fall well within 10 minutes per move, leaving 132 minutes. Allowing another half hour for attention to the loader would leave 102 minutes for car changes. Employing a 5-ton car would require 58 car changes and would necessitate making a shift in 1¾ minutes.

"If switches are kept within 150 feet of the loader the changes can be made well within the limit of 1¾ minutes per shift.

"The arrangements of switches in rooms depends upon conditions which vary not only in different mines, but sometimes in the same mine. It depends also upon whether mules or locomotives are employed, or a combination of both.

"Where cars employed do not hold over 3½ tons of machine loaded coal and grades are not severe, changes by mule have the advantage that by use of a small parting on the room the mule can hook onto either end of the car, and the storage and switching space can be maintained at a minimum length. The big disadvantage of using a mule, however, is the clumsiness in shifting the car during the process of loading in order to fill the car to maximum capacity. The movement of the loading machine at the same time increases the difficulty in maintaining the proper relation of discharge to mine car. In rolling seams, the mule is at a much greater disadvantage than in moderately level beds. Under some conditions a mule and motor would work to good advantage, but the exact system of tracks and combination of equipment for making car changes will remain in many respects a local problem.

"The fact that as examples I have referred to larger tonnages than it has been possible to consistently maintain, with certain types of equipment, may seem to many as being unfair. And especially to those whose hard work has made mechanical loading stand on its own feet, with average output much below the higher figures used. But it is these same fellows who have hit the high marks occasionally. And in coal mine production what seems like a record today, becomes commonplace tomorrow.

"One of the few pioneer operators in mechanical loading only a few days ago, made the remark that mechanical loading was 10 percent equipment and 90 percent organization.

"At any rate, it does play a most important part. To secure this organization requires men with ability to lead and inject the spirit of friendly competition among the different loader sections.

"Many skillful and loyal men utterly lack the power to give orders. Each machine operator should have this ability so as to be able to direct the little gangs backing up the machine and keep them pepped up, so to speak.

"My theory is that if you keep the coal coming off the end of the machine conveyor at a regular rate, the average organization will somehow contrive to take it away as immediately there is competition between the haulage gang and the loader crew, but if the coal is loaded in a dilatory manner, because of a poor operator or poor preparation, at the face, there is no possible arrangement for car manipulation that will make up for this deficiency."

Discussion:

F. F. JORGENSEN, *Cons. Engr., Superior Coal Co., Gillespie, Ill.:*

"I feel rather out of place in discussing this paper because we have no mechanical loaders in our mines in Illinois. Many of you know of the union ruling in Illinois which prevents us from placing any mechanical loaders in the mines until a uniform scale had been made. If the mechanical loaders were used before this ruling went into effect it is permissible to continue the use of them and even add to the number of machines, but if mechanical loaders were not used before the ruling, we are not permitted to install any. I am in a state of perpetual perplexity where mechanical loaders are concerned. I have to revise my ideas on the whole subject about every month and sometimes every day. After studying the problem very carefully I was thoroughly convinced that with any mechanical loader having a capacity of loading 175 tons a day or better it would require either two mules or two locomotives to serve that mechanical loader. Immediately I find a mine that is getting out almost 300 tons a day and sometimes going well over 300 tons a day with only one locomotive serving it."

ADJOURNMENT.

MECHANICAL LOADERS IN PILLAR WORK

ROBERT WALLACE, *Sup't, Pocahontas Fuel Co., Pocahontas, Va.:*

"The mechanical coal loader used by the Pocahontas Fuel Co., Inc., in mining and loading coal from pillars, is known as the *Coloder*. This company mines the famous Number Three and Number Five seams of coal in McDowell and Mercer Counties, W. Va., and in Tazewell County, Va.

"The machine is built in Columbus, Ohio, by The Coloder Co., and it may be described as follows: The machine consists of two swinging conveyors carried by a 4-wheeled truck. A 15-H. P. motor mounted on the front end of the frame drives the self-propel mechanism, which drives on all four wheels. For rapid moving from place to place, a

Getting ready to load coal from end of pillar in Pocahontas mine

Place cut and shot and ready for loading machine

Cutting coal and splitting the pillar. Snubbing cut at angle of two inches to the foot forms wedge shape to the floor

gathering motor is generally used, and the self-propel unit is used only during the loading process. The gathering conveyor is a 60-in. steel plate 14 ft. long, which is pivoted over the hopper at the rear end and its forward end rests on the mine floor. The flat front end is carried on a small pony truck when the machine is being moved about the mine. The gathering conveyor is arranged to form two troughs, which carry the loading and return pass of the gathering chain. This gathering chain is a series of 4-wheeled carriers which hold conveying arms. The carriers are connected by heavy forged links to form an endless chain. There is a hopper at the rear of the gathering conveyor from which the coal is carried over into the mine car, by a drag flight conveyor. A 30-H. P. reversible motor drives both chains. An 8-H. P. motor mounted on the gathering conveyor drives a pocket sheave, which pulls in either direction on a chain extending from one side of the room to the other, held at its ends by roof or rib jacks. Coal is gathered by alternate right, left and forward movements of the gathering conveyor over the mine floor. The loading is continuous as long as there is room in the mine car for more coal. These machines are built as low as 42 in. above the rail, and as high as 63 in. above the rail, depending upon the mine car used.

"The power consumed is about .2 kilowatts per hour. The cost of repair parts and repair labor during 1925 was $0.030 per ton. On 25 machines in use, the loss of loading time, due to mechanical and electrical failure, averaged 9.18 minutes per shift for about 6,000 shifts.

"Pillars are, and for several years have been, successfully extracted in the mines by methods in which loading machines take the place of miners. When loading machines are used, the area of live working for a given output is about one-third that required when the hand loading method is used. The extraction is so swift that few timbers are required and these need no resetting, as is generally required in pillar work by hand loading. Less slate is handled and more lump coal is obtained, because less weight settles on the coal in pillar sections. Pillar coal can be loaded by machines at a lower cost than by hand; in fact, the Pocahontas Fuel Co. claims that the cost of pillar coal mining, excluding the cost of timbering, is less than the cost of room coal. Where loading machines are used, it has justified this claim by increasing the width of the room pillar.

Robert S. Wallace

Machines Increase Speed and Safety

"Safety in pillar work is greatly increased by the use of Coloders. With hand loading methods, no more than two men can work in a split or stump of a pillar. With an average mine car capacity of 3½ tons, four cars would constitute a fair day's work for one miner in a pillar section; consequently two men will recover only about 26 tons of coal from one pillar per day. By loading out one or two cuts per shift, it is possible to increase the output by loading machines, from that pillar, to as much as 100 to 200 tons per shift according to the method of working, whether off the butt or by splitting the pillar and removing the stump. With loading machines the coal is removed from four to eight times as fast as by hand. In proportion to the increased speed, safety is also increased.

"Speed also assists by reducing the quantity of slate to be handled and by decreasing the number of timbers to be set. The claim for increased safety is substantiated by the fact that not a man of a loading crew has been fatally injured during the last five years, while these machines have loaded more than 4,000,000 tons.

Preparation of Coal for Loading Machines

"Snubbing is common practice in the mines of this company. Especially does this practice prevail in the West Mine, where pillar drawing is in the majority. A breast machine has been reconstructed so as to make a cut at an angle of 1½ in. to 2 in. per foot. It operates from a position on a track. The truck of the machine is mounted on 10-in. wheels and carries a revolving inclined frame on which the cutting gear operates. The cutter bar is fed forward mechanically and cuts a kerf or wedge shape, starting about 20 in. high and finishing at or near the pavement. The cutter bar is 10 ft. long, and cuts a place 18 to 20 ft. wide.

Crew Organization

"All of the mine labor employed to mine and load the coal is included in a crew under the charge of a foreman. The crew includes drillers, shot-firers, cutters, trackmen, timbermen, motormen, brakemen, loader crew, slatemen and foreman. The number of men in the crew and the tonnage produced depend upon local conditions. A crew of 18 to 25 men perform all the duties incident to the mining and loading and gathering of 300 to 400 net tons of coal per 9-hour shift. These figures show a yield of 16 net tons of coal per man-day for coal delivered on the sidetrack.

"During 1925, the loading machines working in seven mines produced 1,709,132 net tons of coal and averaged 77,688 net tons each for the year. The real significance of the record can only be appreciated when the total tonnage on which it is based and the number of

mines which took part in that production are considered. Outstanding one-day records of high output per individual machine are not the foundation upon which the success of mechanical loading is based, but rather the day in and day out, year in and year out performance of the machine in use. The consistent and ever-increasing efficiency in mass production is more vital than the best individual production or record.

"One particular point I wish to call to the attention of you gentlemen: You can say all you want, and say what you like, about the mechanical loading machine, and can even send "him" back to work a double shift, and there is no danger of his talking back to you. These things are a great comfort to the officials of a mine and help to keep peace in the family.

"The difference in cost per ton between hand loading and machine loading is from .20 to .25 cents per ton, and according to local conditions.

"Of first importance to the continuous and economical production of coal are uniformity of tonnage and low cost per ton, which features are afforded by loading machines. Much greater concentration is effected by the use of loading machines, and this results in closer supervision, which in turn brings about higher recovery, greater safety and better preparation."

Discussion:

W. J. GERMAN, *of Huntington, W. Va.:*

"Mechanical loading not only in the Pocahontas field but in other fields is making great progress and they are very successful on pillar work.

"A very important point that Mr. Wallace hit on was the live workings necessary with loading machines on pillars. He claims that the area or the live workings for a given amount of tonnage is cut down two-thirds. That brings out a point also that is very interesting in the way of safety. When you can get your loading done in a small section you can have closer supervision over the blasting, loading, transportation and safety of the men. That has been borne out by the experience of the Pocahontas Fuel Co. They have loaded 3,000,000 tons with the loading machine without a fatal accident caused by the machine itself. They have had other accidents but nothing that could apply right to the mechanical loader. That is quite a record because naturally when developing on a large scale, a mechanical loader or any mechanical loaders, it is a big problem, and to get away without any accidents is quite a good record. The mechanical loader in the pillar work is very successful."

MECHANICAL LOADING IN ROOMS AND ENTRIES

I. N. BAYLESS, Superintendent of the Union Colliery Co., Dowell, Ill.:

"While we haven't mechanically loaded coal in tons up in the millions we believe we have made some progress in mechanical loading. Our first experience with mechanical loading was in rock work in December, 1922. We had some rock work to do and we bought a Conway loader which was very successful; by that we decided we should be able to load coal also with this loader, or with a mechanical loader. Our next step was to buy a second-hand Myers-Whaley loading machine. We had varied success with it. We loaded coal up to 118 tons per shift. Our next step was to buy a Goodman power shovel. This power shovel had been developed in the salt mines up in New York and it had never been tried out in a coal mine. We got the Goodman power shovel in October, 1924. Of course we had to educate ourselves to the use of the shovel, but we stayed at it consistently and while for a time we didn't get any big success we demonstrated to our own satisfaction that we could load coal mechanically and that the Goodman power shovel would load coal. We started in and worked with it possibly a month before we got any increased tonnage. We did not want to change our system of mining until we had tried out thoroughly mechanical loading. Our system is the panel system, room and pillar work. The Goodman machine is a machine that will load in wide places and therefore we put this machine in some rooms with the Myers-Whaley machine or in the same section.

"We served both of these machines with one locomotive and one mine machine, with varied success, and we finally decided that we did not have enough territory in this particular section to operate the two machines successfully. We secured another Goodman power shovel and moved the two of them to another pair of panels, which had 20 rooms on the complete panel, or pair. We started out with the two machines by putting one of the machines in No. 1 room and one in No. 2 room, and serving them with one motor and one mining machine. We tried that way for some little time until we found out that one mining machine and one locomotive would not serve two loading machines. We immediately put on another mining machine, or a mining machine to each loading machine, and a locomotive to each loading machine. During this time we had developed quite a number of problems in shooting, etc. Some days we would have plenty of loose coal to load, other days we would not have. Therefore, we had to make a study of the shooting of our coal to make a success of the loaders. After we put a locomotive after each loading machine our tonnage per machine shift immediately increased considerably.

"In January, 1926, we tried a Joy machine that was especially built with a wider throat and wider conveyor. We built up from step to step until at the present time we have eight Joy machines. We have six Goodman power shovel machines and two Jeffrey pit car loaders. We are operating at this time practically 100 percent mechanically. We started this about April 27. At the present time we are getting very good results from mechanical loading, and haven't changed our system of mining any. We are trying to drive entries with Joy machines and the Jeffrey pit car loaders, loading room coal with the Goodman machines.

"We had of course, our problems in cleaning coal. There was no way that we found to mix hand-loaded coal with mechanically loaded coal. We thought if we could clean that mechanically loaded coal we could load the two together. We are now doing that and are getting as clean a coal as we would get by hand loading. We have had analyses made which really prove that we are doing it. As far as records are concerned, I have a number of records here for days, for months and for a period of six months. However, I don't think that it is the policy at this time to go ahead and give records. I have three days straight mechanical operation here. The six Goodman loading machines on May 8 loaded 1,777.79 tons or averaged 296.3 tons per eight-hour shift.

"The machine that loaded the most tonnage on that date loaded 408.9 tons. The machine that loaded the smallest amount of tonnage was 229 tons. I might say that the average with what we call a number five and six machine was low, for the simple reason that the operator had just started. At that time we had six Joy machines. The six Joy machines loaded 1,358 tons. The two Jeffrey pit cars were double shifted. We have three men who shovel on to those Jeffrey pit cars and the average per shift was very low. We are getting an average of approximately 55 tons per shift on each Jeffrey pit car loader or 110 tons per shift on the two. That is about our average.

"As to the men who operate these machines. Our two Goodman machines are operated on one motor. We will start one machine in No. 1 room on one entry and one machine in No. 10 room on another entry. The two men on the Sullivan shearing machine shear the coal on the track. We timber down the center of the room in using the Goodman machine. We have now in opera-

tion two Joy shearing machines that are on caterpillars. We shear the coal twice with them and that eliminates two snubbers. Instead of 28 men to the two machines we now have 26 men to the two machines. As I said we are working the Joys in entries. We experimented and as far as my knowing at this time to just what extent we will go in mechanical loading—I do not know. I don't think there is anyone at this time who can tell us what we can eventually do with mechanical loading. The big problem is a matter of education. Not education of the men at the mines, but education of the management. They must educate themselves and they must be liberal in allowing for a number of mistakes. We have had the ordinary run of minor accidents but we have had no serious accidents due to mechanical loading."

Discussion:

L. B. SMITH, *Assistant to the President, Chicago, Wilmington & Franklin Coal Co.:*

"There are one or two things to be considered when you are contemplating changing over to machine loading from hand mining. In the first place if you have a shaft mine and your output is limited by the size of the pit cars, it is necessary to figure what effect the loading of your pit cars by machine is going to have on your total output. I do not believe it is possible to get as big a tonnage on a pit car when loaded by machine as it is by hand loading, and your output if you have reached the capacity of your hoist will be limited to some extent. The benefits of mechanical loading will offset all of these things, but that is a point to be considered in figuring the cost. Another and more serious problem is the cleaning of the coal. I do not believe from our experience, that the mechanically loaded coal in the large sizes, where you have any impurities in your coal to start with, is very much dirtier when it gets on top than hand loaded coal. Some provision must be made to clean it for a competitive market.

"Another point in observing records of mechanical loading is the very large variation that you get from day to day. As men get more experienced in the operation of the machines these variations will gradually be reduced, but at the present time from any records that I have been able to obtain the tonnage produced on one or two or three days cannot be approximated over a period of any extent or with a large number of machines. That should also be taken into consideration. At this time we are still in what I call the experimental stage. At the New Orient Mine, where we are operating machines, we are gradually eliminating difficulties and it is an inspiration to find somebody who is getting the big tonnages that Mr. Bayless has been getting."

MR. MCAULIFFE:

"Without reflecting on the labor that lives in Southern Illinois, I do know from my experience that that labor is quite as critical as any other labor in the world. Again it is a problem of education. Those men have undoubtedly a very good side and when they are finally convinced they will go along and undoubtedly Mr. Bayless has convinced a good many of his men that mechanization is a very good thing and is a growing institution. The conditions as regards bottom and top and caving at the Kathleen Mine were not the very best, there were numerous faults, and all of those things Dr. Young has had to contend with. I would say that his conditions are not better than mean.

"Now, Mr. Smith has said very properly that we will get most extraordinary differences in the day's output of individual machines. That has been our experience. Sometimes we will start in with perfect good faith and wind up with 20 tons. Those things will gradually iron out. Then again in a large operation when you are fully mechanized, or even in a medium sized operation, the machines that fall down will be balanced to a large extent by those that do well, so that at the end of the day you will get the same tonnage that you got yesterday."

MECHANICAL LOADING OF TOP AND BOTTOM ROCK IN ENTRIES

A. C. HOHNKE. *Sup't, Russell Coal Mining Co., Clymer, Pa.:*

"In submitting this paper on 'Mechanical Loading of Top and Bottom Rock in Entries,' I feel that a brief description of the mine in which I have used machines and the method of mining is essential to a clear understanding of our use of machines.

"The mine I have reference to is the Russell Coal Mining Co. No. 45 mine of the Peale, Peacock and Kerr interests at Clymer, Pa. The seam we are working is the 'B' or Miller seam which at this mine averages in height about 38 inches of clean coal; immediately over which is 4 inches of 'boney.' The roof is a laminated shale and the bottom is a bastard fire clay.

"The rise workings in this mine are on the three entry system and the dip workings on the four entry system. All entries are driven 11 ft. wide and sufficient top or bottom taken to give a clearance of at least 6 ft. from the rail to the roof. It is our practice to take top rather than bottom, but as the bottom has many rolls, it is often necessary, after driving some distance ahead, to return and take bottom and make grades.

"This mine was opened in the summer of 1923 and, as we were very anxious to get rapid development and knew that we would have a great deal of rock work, we decided to load our rock mechanically and for that purpose a Myers-Whaley shovel was purchased and put into operation in August of that year. This machine proved so successful in handling our rock, that a second machine was purchased and put into operation the following February.

"With these two machines we have taken a total, to date of 11,000 yards of top rock, from 36 to 50 in. thick, 11 ft. wide, and have also taken, to make grades, 2,000 yards of bottom rock from a few inches to as much as 9 ft. thick, machines being used to do all brushing and grading necessary in the mine.

"When we put our first machine in operation we had to feel our way and work out a system for its use, for at that time there was no other machines being used for this class of work and we were therefore not in a position to profit by the experience of others.

"The system we found to give us the best results in handling top rock and which we finally adopted after making a number of experiments is as follows:

"We load the coal out by hand for a distance of at least 100 ft. or more, laying permanent rail and we go before any rock is taken, and in preparing places for shovel we pay quite a little attention to our shooting, for if rock is not properly shot a great deal of hand sledging or mud capping is necessary which seriously retards the progress. We have found, however, that where two shots are fixed simultaneously, one on either rib, that practically no sledging or mud capping is necessary; the rock being well broken and the entry nicely squared up. As soon thereafter as coal has been loaded out and permanent rail laid, a portable compressor is moved up and rotor drills with 12-ft. steel, are used to drive one hole on each rib, and shots are fired simultaneously by a low voltage battery. After two or more shots are down or enough to enable drillers to drill and shoot workings from the top of the rock pile without interfering with the shovel, the loading machine follows into the heading and up to the face. Sometimes if coal has been taken out far enough ahead there may be a week's work for the machine in one heading, but we never have less than a shift's work for it in any one place.

"We have found that in shoveling on top of the rail in this manner no clean up work is necessary back of machines as the fine rock left is just sufficient to ballast the road nicely.

"With further reference to our method

Myers-Whaley Shoveling Machine

of shooting, wherever practicable we shoot the rock the entire distance to the face before the machine moves in. This prevents any delay for shooting and insures continuous operation of loading machine, barring delays due to shifting cars and waiting on trips. Under these circumstances we are consistently averaging a loading of 80 one and a half ton cars per shift. Our record for this work was 126 cars in an 8-hour shift. During this run cars were loaded at an average rate of 1½ minutes per car.

"For taking top rock with machine we consider the following a full crew:

"Two men to drill and shoot.

"One man to operate loading machine.

"One man as loading machine helper.

"And where grades are so steep that it cuts down our efficiency to handle cars by hand, one motorman is added.

"As I have mentioned before, we do not take bottom except to make grades, but in taking same, machines have proved equally successful in reducing our costs and speeding development.

"In taking bottom it is not possible to make the same yardage as when taking top, due to the fact that track has to be laid for the machine as it advances and that sometimes the machine is held up while drilling and shooting is done. The delay incidental to laying track we have very much reduced by the use of 7-ft. built up sections of track that can be laid in 10 minutes and in taking bottom we drop our shovel so that it operates about 8 in. below top of rail, thus making its own bottom.

"When we use machine on bottom work a crew consists of three men who operate machine, drill, shoot, lay track, shift cars, etc. The average loading under these conditions is about 40 cars per 8-hour shift.

"Having operated these machines for nearly three years, part of which time they were on double shift, I think the following figures as to maintenance costs may be of interest:

Lubrication, waste, etc., 50 cents per day or one-third cent per ton.

Actual cost of replacement material figures on tonnage handled, 2 cents per ton.

Labor on repairing machines based on actual tonnage handled, one-third cent per ton.

Total cost of maintenance and upkeep 2 2-3 cents per ton.

"As my experience with machines has been in a new mine where no yardage scale had been established for taking rock by contract, I am in no position to state our exact saving per yard by use of machines, but for sake of comparison will give the yardage rates in an adjoining mine where conditions are the same and will compare them with machine costs for similar work.

"In the mine I have reference to, the contract price for taking top rock 24 in. in thickness is $3.27 per linear yard or 13.6 cents per inch for entries 11 ft. wide and costs of hand loading as compared to machine loading are as follows:

Height of rock	Hand loading cost per yard	Machine loading cost per yard	Saving per yard	A saving of
24-in.....	$3.27	$2.45	$.82	25.0%
30-in.....	4.08	2.82	1.26	30.9%
36-in.....	4.89	3.09	1.80	36.8%
42-in.....	5.71	3.26	2.45	42.9%
48-in.....	6.52	3.40	3.12	49.9%

"In closing I would say that the saving in actual cost of brushing with machines, although large, is often of secondary importance as compared with the indirect saving gained from the speed with which work is accomplished.

"As an example of this, take an 11-ft. entry as loaded by hand. In an entry of this width only two men can load efficiently (any more would be in each other's way) and on an average these two men will load about 24 tons of material per shift. On the other hand, in an entry of similar size, the loading machine with a crew consisting of from 3 to 5 men, depending on conditions, will load approximately 120 tons per shift, thereby increasing tonnage handled and yardage gained about 5 times.

"In my opinion, therefore, I consider that the rapid development that can be secured by use of machines is of even greater value than the direct saving over hand loading costs and that to secure the full benefit from use of machines rock should be properly shot and an efficient system of car shifting worked out; in other words, it's not what the machine will do, but what you do, that will make their use a success or a failure."

Discussion:

L. W. HOUSEHOLDER, *Chief Engineer, Rochester & Pittsburgh Coal & Iron Co.:*

"In discussing Mr. Hohnke's paper—in reference to taking top and bottom with Myers-Whaley machines, we have been using these machines for four or five years and have had very remarkable success. Our savings in a number of cases are somewhat larger than those quoted by Mr. Hohnke, but the two or three most important things that must be done in order to make these machines a success are: that first, your cars must be low enough that you can mine out the coal ahead at least 50 ft., in order to make any required saving. In other words you have to take the coal out and then bring your compresser in and make a real job of shooting your rock. You can't take out one or two cuts and make a success of it. If you get your cars right up to the face and take your coal out ahead of your rock and have two or three shifts you will have a good paying proposition.

"Second, you must have somebody who understands thoroughly the shooting and drilling of rock. This work must be handled by people who know how to break this rock up in chunks 12 or 15 in. square, because if you get flat slabs the machine won't handle them. We have had a great deal of experience on these machines in driving solid rock tunnels. We just completed a 1,200-ft. tunnel that had an average width of 11 ft. and about 6 ft. high. We tried this tunnel by hand work and we finally put in a Myers-Whaley machine and we saved on this job about $25.00 a yard over hand work. The up-keep of these machines compares very favorably with what Mr. Hohnke told you. We have had very little trouble and very little delayed time due to break-downs or repair work. One most important thing that you must bear in mind is that you must keep good power. The motor rating is none too large and it is absolutely essential that you have full voltage at all times."

METHODS FOR MINING THIN FLAT SEAMS WITH MECHANICAL EQUIPMENT

This paper was to have been presented by Mr. C. W. Wagner, Engineer, Glen Alden Coal Co., Scranton, Pa., but a train wreck prevented his arrival in time for the discussion. Mr. Charles Enzian, of the Berwind-White Co., discussed the subject.

***CHARLES ENZIAN**, Chief Engineer, Berwind-White Coal Mining Co., Windber, Pa.:*

"I am most familiar with the Central Pennsylvania district which the universal system of mining is the room and pillar. The Berwind-White Coal Mining Co. have, however, had some experience with other systems of mining. The long wall system on the advancing has been tried and found very satisfactory. The roof conditions were very difficult, being a burden of approximately 600 or 700 ft., the immediately overlying part being soft. The face was supported by means of 15-ft. packed walls. The rock for these packed walls was brushed from 15-ft. trenches. The coal was undercut at the beginning of the face and then blasted and loaded into Link Belt conveyors by day miners. Later these men were paid on a task basis. The conveyor of course discharged the coal into the mine cars along the long wall cutting.

"The Miller Seam in that district contains a large number of rows in the fire clay bottom and also a large number of clay veins which you of course recognize as very serious factors to contend with. This system was satisfactory however, but was discontinued through a change of operating officials and other conditions beyond the control of the management.

"Just recently a long wall system has been tried in another of the Windber mines which has advanced under the re-retreating system and retreated upgrade. This, as you will recognize immediately, has the advantage of self-drainage. This face was worked by hand and also by machine under-cutting. The results per man-shift are approximately the same, but on account of the peculiar construction of our coal and roof conditions it is only fair to say that the under-cutting machine could not perform to an advantage and it has since been discontinued. The yield per man-shift, however, has not been materially increased under the hand mining and is about an even break. On that phase the rock packed walls were also used, but on account of heavier roof the packed walls were built 10 ft. wide with 10-ft. trenches between. The cost of building the packed walls and the additional timber required did not result in a favorable per ton cost. They are still continuing it and are gaining experience.

"The Miller Seam floor contains in addition to a large number of rolls, a thick belt of black slate and very consistently the clay seams are present of course. In this entire face there has not been a single shift in which we had less than five rolls, two clay veins and a black slate. We feel that the results that have been obtained are representative of the maximum difficulties that might reasonably be expected in the Miller Seam.

"Another system that has been tried and so far has proven very successful is the Conveyor system on the work in rooms and pillars. Our experience in that has not progressed far enough to give dependable data, but the tons per man-shift have very materially increased over the hand loading method and we expect to work this conveyor on the block system, drive up the room 24 ft. wide and bring back a 36-ft. pillar with two of the sectional face conveyors. The average per man-shift to date is approximately 11 tons. All these systems, however, include the very serious problem of manual labor. No mechanical system will be entirely satisfactory until the maximum amount of manual labor has been reduced. As one of our co-workers has said, the only mechanical system that will be a success is that system that will take work out of work. We have continued our studies and investigations and through the kind cooperation of our neighboring operators, we have had an opportunity to study their mechanical system.

"I should have said probably at the outset that the coal of the Miller Seam in the Windber district averages 3 ft. 3 in. You will recognize of course the impracticability of the common type of loading machines. It will be necessary to design a more or less special machine for our conditions.

"Another system, which we feel gives great promise is the scraper system, scoop and scraper system, and we are at the present time installing a Goodman Type B *Entryloader*. We will experiment with one block at first and if that proves successful, especially as to roof control, and the cost basis, it is expected that more will be installed. That system of mechanical loading which is also partly a mining machine appears to possess the greatest promise of taking the sting out of labor. At first we will load into mine cars supplied by a run-around track, with motor, and then feed to the loading machine by room hoists with remote control. If more than two machines will be installed on an entry it is our present plan to install a thoroughfare conveyor, probably a belt type, throughout the entire room heading length.

"From a hurried and casual survey of this subject, I have jotted down a few salient points which we feel must apply to any system of mining thin seams. First the coal must present favorable mine conditions; second, it must involve the least amount of manual labor; third, it must present the greatest factor of safety to your employe; fourth, it will be necessary to have favorable operating conditions and the officials and workmen must possess the proper psychology, because as we now recognize and have been told by a number of speakers today, anyone who enters the field of mine mechanization must be prepared to meet and endure and overcome keen disappointment.

"Another factor—the mechanical mining system must present the lowest practicable mining cost. It should possess and will appeal mostly if it does possess the lowest total installment investment. It must possess the greatest possibilities for cleaning the coal at the face or on the tipple, and it must make possible the recovery of the greatest percentage of coal. We are practically of the conclusion that in our district, the mechanization of mining must go hand in glove with mechanical cleaning at your tipple."

INSIDE MINE CONVEYORS

***NIXON W. ELMER**, Cons. Engr., Quincy, Mass.:*

"It will help me if you will bear two things in mind: First that this talk is from the point of view of the material handling engineer and, second, that while mine is an engineering point of view, it is neither that of the operator nor yet that of the manufacturer. Such an outside viewpoint may be made of use. Most of us at one time or another have been so close to the trees we couldn't see the woods.

"From the time the coal has been shot down out of the solid, till that coal actually meets the flame in the consumer's furnace, isn't it largely a material handling problem?

"In Well's well known Outline of History, he says: 'For a hundred years power has been getting cheaper and labor dearer. If for a generation or so machinery has had to wait its turn in the mines, it is simply because, for a time, men were cheaper than machinery.' This was written some years ago but the thought was so clearly expressed that it could hardly be improved upon today.

"It has seemed to me for several years that the industry has, as a whole, unconsciously underestimated the strength and magnitude of the economic forces leading us on towards economically complete mechanization of our under-ground operations. Let us glance for a moment

at three of these economic factors which have been influential in bringing about mechanization, I refer to Demand, Supply, Labor.

"First. Demand—While the use of power has been increasing year by year in leaps and bounds, the coal requirements have not so increased, because the enlarged demand for power has, in the aggregate, been largely met by improvements made in the economical burning of the fuel. Every now and then some one cheerfully announces that now we have reached our limit in this direction and further growth in the use of power must mean a corresponding increase in coal consumption. Don't let us fool ourselves! There is still at least a generation ahead of us of rapid progress in power production economy above ground, and the operator who waits for relief from this source, will be disappointed.

"Second. Supply—The discoverer, promoter and developer of new coal mine properties, we seem always to have with us. That unfortunately profitable business will continue to afflict the coal mining industry until a controlling minority of our operations are able to establish profitable year round operation at below Snow Bird costs.

"Third. Labor—Here politics has stepped in, cutting off our supply of cheap, ignorant and non-English speaking labor upon which the whole industry has become dependent. This is a very painful shock, that kind of a kick always is, but I believe fully and with all my heart that it will turn out that we have been kicked up stairs!

"Could cheaper Fords be built with cheap labor? If so, why doesn't some one do it? Wages under-ground are high enough *now* to attract American born labor, if only the working conditions conformed to American ideas of skilled labor, and the work itself was less uncertain. The first requirement, that is making the working conditions correspond to American ideals, is obviously attained as soon as success in mechanizing is achieved. I believe the second requirement, steadier work, is more nearly within our grasp than we think. Certainly the mine which is able to mechanize fully will be able to undersell some others, it will need fewer men and may naturally expect to operate more days in the year.

"Granted these premises, the Americanization will attend to itself; in fact, it becomes a species of infiltration, to use an Army term. Its effect, however, is accumulative and will accentuate the benefits of mechanization long after that subject itself has become uninterestingly commonplace.

"It is with reluctance that I tear myself away from easy generalizations. Being a material handling engineer and having been such all my life, I have been actively employed in that phase of the mechanizing of a good many industries, and have seen the same costly mistakes repeat themselves in each. If I am able to point out these attractive errors clearly enough, I shall not have taken up your time in vain.

"In speaking of the first of these factors which have been, and are acting as brakes on our progress, I need your indulgence very much, because your first and instantaneous reaction will be to promptly and enthusiastically disagree with me! I refer to the custom which has grown up in the industry of buying machinery on 60 days' trial. This is doubtless a useful arrangement for buying standardized machines which have to be used *as is*, all necessary adjustments being made in the manner of its use rather than in the machine itself.

A. C. Callen
Who Presided at the Session Devoted to Underground Conveyors

"The application of this system of buying on trial to conveyors, however, is a serious mistake. This attitude has led or induced some conveyor manufacturers to try to comply with this apparent demand by attempting to design, manufacture and stock a standardized and would-be universal conveyor, which they can afford to sell on trial. The hope of the manufacturers is, of course, that enough of the trial operators will find some use or other for the thing to enable that part of their business to pay expenses and show a profit. Naturally it is not really good business to sell a customer something he thinks he wants, but does not need. Back of it all, however, the blame rests more with the custom of the operators of buying on trial than with the conveyor manufacturers.

"Conveyors are, in the matter of their design, extremely flexible, so that some type or other can be designed for and adapted to almost every occasion or use. But once designed and built for those particular conditions, this conveyor becomes a makeshift when transplanted to other conditions and uses. This means that your first problem is to study your conditions and find out what you want to do, and then select and design your equipment to best accomplish this purpose.

"Experience above ground teaches us that we should always design the conveyor to fit our conditions instead of modifying the conditions to fit our conveyor. Our failure to follow this constructive procedure is the real cause back of the attempts to produce a universal mine conveyor. I think I can best sum up the qualities and advantages of a universal or many purpose conveyor in the words of an old workman I met under appropriate circumstances, 'It's just one of them there animals that can't live in the water and dies on land.'

"It would be easy to blame the conveyor manufacturer for the slow development of handling equipment specially designed to fit the individual needs of the coal mines, but a little thought will show that it would not be fair. No manufacturer of a competitive, non-patentable article which can not be put into quantity production can afford to spend much money for development. He can never get it back, because his competitors can copy at once and undersell him if he tries to collect the money he has expended on research. This is a condition, not a theory, and progress here will lag until this fact is recognized and frankly met in a cooperative spirit.

"Going back to our subject, things to be avoided: Many operators are buying sample conveyors of one or more types and are experimenting to find out what each type will and won't do. Such redetermination of old and known facts is pure waste. It is the misfortune of the coal-mining industry that so few operators are carrying on experiments with a definite plan and end in view, toward which success in their experiments will advance them. As a matter of fact, until we know where we are going, we aren't even on our way!

"All conveyor design is a compromise. On the other hand, any conveyor can be made to do almost any conveying work. But it should not be! Each type should be used for the work for which it is best fitted. Granted this as a starting point, much more can be usefully done in detail modification of even this selected best type to adapt it to meet local conditions. In other words, don't play favorites and try to make the mine fit anybody's pet conveyor.

"Specifically, a conveyor could easily be designed for use along the face, down the room, and along the entry interchangeably and, in fact, be made to work about as well in one place as the other; but that wouldn't be because it was particularly efficient in any one of the three places! The requirements for a conveyor to take away the coal as shot down at the face, to transport it down the room, and to handle the product of all these

rooms at once are fundamentally different, so that any compromise attempt to fit all three must be below par for at least two out of every three purposes. Before you and I were born people were searching for a satisfactory multiple purpose conveyor, but unless you have joined that religious cult which believe it better to seek than to find, don't join in that particular search!

"Another costly and unfortunately common procedure is to begin our experiments at the beginning and repeat experiments already carried to a definite and established conclusion in above-ground coal handling. The arguments in favor of this practice from the educational viewpoint are specious and attractive, but about the time the individual begins to acquire an education in this way, the management fires him for not getting results. For our illustration let us take two age-old problems:

"First. Where an intermittent device feeds one of the continuous type.

"Second. A continuous conveyor feeding an intermittent type of carrier.

"An example of the first is a cable scraper discharging onto a belt or chain conveyor. An example of the second is where a belt or chain conveyor discharges into cars. Such problems are as old as the material handling industry itself, and there is nothing but grief to be gained by re-solving them. Let us then make up our minds to start where contemporary industry has left off instead of where it began long years ago. To conclude this part of my remarks, let me repeat something I have frequently said before: 'There is not, and never has been, one best method of handling bulk materials mechanically. Success follows a wise selection of mechanical means, where the machine and the method are respectively so modified and coordinated that they work together to the best advantage.'

"The more important and most valuable progress in the mechanizing of other industries has usually been made through step-by-step methods rather than by one spectacular jump, though this latter is the more interesting way to have the other fellow do it. This is what we should expect, because economic considerations put a premium on the fullest utilization of existing facilities, the wearing out of existing equipment in some useful service before discarding the type.

"If, then, mechanizing is to be gradual, step by step, there is the more need to visualize our goal before we take the first step. Visualizing the future mine, we will each see his own picture, but the more our vision is guided by the experiences gone through during the throes of mechanizing other industries, the nearer prophetic our foresight is likely to be.

"Mechanization means concentration. They go together. To attempt one without the other is to fail before we start. As the mechanizing progresses mining must become more concentrated, and as concentration increases the point of congestion, or neck of the bottle, moves farther and farther away from the face. Obvious as this appears to the material handling engineer, the operator is frequently taken by surprise when this congestion occurs. The operator must have hoped for success or he would not have tried, but nevertheless he frequently has not made comprehensive enough plans to be able to take full advantage of the results actually achieved. I have seen a mechanizing scheme work out well, and yet fail merely because the conveying arrangements were so designed as to be inadequate to meet the conditions of full success. Unconsciously that operator played to lose!

"Everyone knows that some time, somehow, machinery must replace much of the hand labor underground. Just what form that machinery will take none can know in advance. It is interesting, however, and can't hurt anything, except possibly the speaker's reputation, to try and foresee the answer. I am not afraid to take that risk, and the attempt must either interest or amuse you, so let's go!

"The earliest efforts to mechanize in every industry generally take the form of the slavish substitution of machine for man. However, I can not recall an industry which has actually achieved mechanization through duplicating manual operations in detail and sequence by machinery. Undoubtedly the human hand is the most universal mechanical device known, but that fact in itself should be a warning to us not to use it as a pattern upon which to design a single service machine.

"The vision that I see, the coal mine of the future as I visualize it, will be small in area, with few locomotives, tracks, or cars, and will have belt conveyors down the long working entries. The number of these entries working will be about one to every six or eight hundred tons of mine output. So far it seems to be fairly plain to me, but from here on I can see double! Following the line of least resistance, I am going to close my eyes to what I see in a thin vein and take you with me where the seam is thick enough for us to walk upright. There I seem to see face conveyors with caterpillar loaders moving along between them and the face and continuous streams of coal moving along toward the entry like the branches of a tree whose trunk is the entry conveyor.

"Both the mechanical loader and the various types of conveyor have their place in this picture, but I believe that the first step should be to develop the conveyor face system with hand loading and bring that step to a condition of reasonable working perfection *before* introducing the loaders. Conveyors alone are not the answer, the loader alone is not, but if we start with the loader we are going at the problem in the most difficult way; introducing more unknowns at once into the equation would be the engineer's way of expressing it.

"On the other hand, the hand-loaded conveyor installation will give time and opportunity to work out our roof problems under rapid extraction, will pay its way as it goes, will postpone our cleaning problem till we are ready for it, and will leave nothing to be undone or unlearned when we are ready to introduce the loaders."

Discussion:

GLENN SOUTHWARD, *Consulting Engineer, Elkins, W. Va.:*

"A discussion on the general subject of inside mine conveyors is rather difficult, because I don't know anything to say on the subject that hasn't already been said. After listening to Mr. Elmer's paper he has expressed my own thought so nearly parallel that I simply want to very briefly mention one point. His view is that of material handling engineer, and for that reason is especially interesting. We are all familiar with every controversy we have on every type of equipment. A conveyor manufacturer told me recently that 'You want the impossible. The type of conveyor you want would resemble a garden hose—one that you could roll along the ground and turn corners with.' I agreed with him. I would also like to be able to roll it up on a reel. What is it we are trying to do? Primarily to reduce the cost of mining coal, and the question for us to decide, or at least discuss, is what we may expect conveyors to contribute to that end. In this there is no disagreement between any of us or between the operator or the manufacturer. Mining is largely a question of transportation, and it seems to me that it is right on this particular point where we begin to have different views. From the manufacturer's viewpoint the problem is simple.

"Conveyors, of course, can not be expected to do more than transport coal, but in adapting this new method it must follow that the mining cost is to be reduced. Haulage is only a small part of our mining cost. We can't ask the manufacturers to do more than reduce the haulage cost, but our aim is to apply conveyors to our mining in such a way that we can cut down our mining, loading, cutting, drilling, shooting, upkeep, etc., to the tipple. Now is it possible to do this. We have had conveyor operations in different parts of the country

for several years. We know that it is possible, we know that it has been done, done simply by concentration."

F. B. DUNBAR, *Hillman Coal & Coke Co.:*

"We all are interested in anything that will reduce cost, and Mr. Elmer being a construction or equipment engineer may be able to tell the fellow who is hoping to use conveyors how he can use them. We know that we can not afford to put a lot of money into equipment that can only work probably 20 percent of the time. We want to know how to use that conveyor at least 80 percent of the time, and that is the problem that we have to face as far as conveyors go under our conditions. I think Mr. Elmer said a very important thing when he said the conveyor must fit our conditions and not try to make the conditions fit the conveyor, because there is exactly where we are going to get into trouble and where we do get into trouble.

"I have used conveyors, and I am using some conveyors as an experiment. The trouble that I am up against is getting the cutting done. The cycle of the cutting is the problem, or one of them, that bothers us, especially when you have tried to adapt your conveyor to your room and pillar, and where you hope to get, and where you must get, 90 percent extraction. But in the low seams where your coal area is expensive and where you must get for your roof conditions enough extraction to make sure you are going to get a proper break and bringing your rib back properly, the question of getting your coal cut and completing your cycle so rapidly that your conveyor will be in operation a sufficient time to make it pay for itself is the stumbling block.

"Another thing is your roof condition. If you have 8 or 10 inches of draw slate, it must come down or it will be a detriment to your conveyor and hold it up, and this draw slate must come down with hand labor. Therefore first you have to cut, drill, and shoot, then clean the slate, and then load the coal. I want to say from my experience the loading takes the least time. The recovery of the posts, the fact that you do not have to lay track, and many other things should be taken into consideration in figuring the cost, but if Mr. Elmer or somebody else can tell us how we are going to cut this coal, this is a matter that we need to give considerable consideration to.

"The mining industry as a whole is accused of not being progressive, but the fact that the number of men that are here this morning proves that the operating man is interested in getting out his coal as cheaply and efficiently as possible."

MR. ELMER:

"I would find out what I needed, and then find a conveyor that would meet that condition. I was very much interested yesterday in Mr. McCullough's and Mr. Pryde's description of the duckbill shaker loader. The idea of using the end of a shaker conveyor as a loader has interested me for several years. I don't think he would mind a radical step in carrying a thing through. I suggest that he experiment and carry that thing to its logical conclusion. Take a duckbill and mount that section on rock or iron and hang it between the tracks of a caterpillar tractor—small one—then start the caterpillar through to the end as fast as it will go, and the stuff will be carried away."

MR. MCAULIFFE:

"I really believe that what we need to solve this problem is just a little bit more psychology, more vision. I know that if we undertake to attack that problem with vigor we are going through. Now, as to the practical situation:

"We will have to build up, as much as the railroad lines have, our transportation units. We want larger cars, and if we bring that condition about it might be well to establish a rail ahead, somewhere quite remote from the supervision which is a shifting proposition. We make all our mine geography on the face, so my thought is that if I were undertaking to build a mine and could get the capital today, I would want a very substantial roadway with a very big car and then get a light conveyor which would be flexible. Of course, there is a problem preceding that situation, and that is how to get the coal on the conveyor. I can not agree with Mr. Elmer that the conveyor can be made much of a success as long as we have to shovel the coal on to it. I think we will have to develop some mechanism to put the coal on to the conveyor after it is shot down, and I have in mind that, regardless of how bad some of our employers feel about foreign laborers, that this condition is going to continue, and that the young men who are growing up today are going to be less and less disposed to accept hard manual labor.

"One of the very serious drawbacks to the mining industry is the extremely poor loading factor that is maintained. Our mines are not working 44 hours out of a possible 144 hours a week. That loading factor is inadequate for many reasons, and perhaps it affects the cost of mining more than any other one thing that we have to contend with. The forces of nature are working on that mine every hour of the 24. That costs money. We have too much idle time, and one of the things I have visioned for the coal industry is continuous operation. Some Henry Ford is going to get up some day and start a mine with a limited area and operate that mine on one continuous cycle, and this question of state laws and regulations and everything of that sort will all have to be rewritten and rearranged to meet the demand. Given continuous operation, well supervised, well ventilated, limited in area mines where mentally alert men are working all the time, and proper methods, many of the regulations that we have today can be wiped out at one stroke. That may sound revolutionary, but when that time comes our explosive hazards, etc., will all disappear."

MR. J. E. MARSON, *Barber-Greene Co.:*

"The manufacturer has a problem which is just as big as yours. He has got to make money, the coal man has got to make money. When he comes to you to offer his devices, he doesn't come to revolutionize your material handling methods. He wants to help you. I was very interested in listening to this discussion, because in the last year I have called on quite a few coal operators, and not because we were building anything that we thought you could use particularly, but because we thought we might be able to build something to help you.

"The first thing that we run into, of course, is just like the first speaker said: 'A conveyor must be able to be reeled up and put in the corner.' A slight exaggeration—but it seems to me from my study of your problems that you want to take this coal right from the face and put it in the cars. That has never been possible in any material-handling problem that was ever developed. We can't even do it in a retail yard where we handle a few tons of coal. You have three distinct problems: One is bringing it down your advance to your main passageway, then down the main passageway to your tipple, then from the tipple to the cars. I believe that a machine can be built to carry the coal from your passageway to your cars, but when you have two points and you want to deliver coal from one point to the other, and those points are growing steadily farther apart from each other, it is impossible to do that with one piece of equipment. What I have tried to do is give you the problem as I have seen it in my study of a year or so, in trying to arrive at something we could standardize, give to you at a low cost, and which would eliminate some of your hand labor. I do not believe the proposition is impossible to approach.

"We all have a tendency, when a new problem comes up, to go at it by a very mysterious scheme, putting in a lot of wheels and cables and then eventually, after the scheme develops, we eliminate and eliminate until we have a machine that is very simple. That is the story

Photographs of conveyors in use at the Knickerbocker Smokeless Coal Company

I wanted to give you. Whether it can do you any good or not, I don't know."

MR. ENSLEY:

"We have the manufacturer on one side and the mining man on the other. The mining man knows his problems. He is trying to tell them to the manufacturer. The trouble, I think, the greatest trouble, has been that the manufacturer has not learned the language of the mining man. I do not believe that mechanization of mining is going to be very much of a success until we get more mining into mechanization."

MR. SMYTH:

"What we are trying to do is reduce human effort. What we are looking for mostly, and what is not on the market is some flexible, easily handled shearing machine that can cut any place in the room and can be moved along the face of a room. If you take one with a long cutter bar, it takes up too much room."

ROOM AND PILLAR MINING WITH CONVEYORS

***R. A. SUPPES**, General Superintendent, Knickerbocker Smokeless Coal Company, Johnstown, Pa.:*

"My paper will be on room and pillar mining with conveyors, which I have been superintending for the past 15 months in two mines. Three conveyors are working in 42 inches of coal at one mine and one conveyor is working in 23 to 44 inches of coal at the other mine.

"The problem, as we find it, is, first, one of transportation; and, second, one of loading. We have been devoting all our time to the first from a mechanical standpoint. Further, the problem is not one of finding a new system of mining or designing a piece of equipment and adapting a mining system thereto, but one of adapting a mechanization to a system of mining which has been tried and proven. The room and pillar system is the one which has been used for many years in Pennsylvania. We have experimented to some extent on long wall work.

"However, it is my belief that we must retain the room and pillar system and make our mechanical problems fit that condition, because we will be able to cope, separately or collectively, as the case may be, with all conditions of roof, bottom, and coal seam. We encounter, during the life of a mine, many difficult conditions, such as good roof, bad roof, hard bottom, soft bottom, rolly bottom, horse backs, slips, clay veins, cutters, local dips, local raises, water, and low and high coal. The room and pillar system will work most successfully under any of these conditions.

"Any mechanical system applicable to the mines as they are now projected and worked will be most successful and acceptable. Besides I have felt that the very simple feature of roof control should be retained, and we find this problem largely eliminated with the room and pillar system. It is possible to control the roof using other methods of mining, but not with the same economic outcome.

"The room and pillar equipment which I have in mind consists of one main drag conveyor from 250 to 300 feet long, driven by a 15 H. P. motor; two 12-inch face conveyors, driven by three-fourths H. P. motors; 1 mining machine; one 1½ H. P. distributing fan; one 5 H. P. hoist; one face flood light; and one firing battery.

"A room face is widened at a 32° angle. When in 40 feet, the first face conveyor is put into use, and at 50 feet the second face conveyor goes into use. These, of course, overlap, and are adjustable to the width of face. It is highly advisable to place face conveyors as close to the work as possible. At 60 feet in the first cross-cut is started.

"Five men are employed to do all the work at each face. Two men usually employ themselves in cutting the face, one operating the mining machine, and the other scraping and setting a row of temporary props 18 inches from the coal. The other two face men, after finishing the loading out of all coal at the left side of the face (cycle is from right to left) follow up with drilling holes for shooting.

"A face man signals operator on the heading to send up material for extending main conveyor, which includes a section of conveyor pan, a 12-foot length of chain, cap pieces, and props. The conveyor is stopped by a face man upon material reaching the tail end. One face man and the heading operator add a section to the main conveyor. This takes from 7 to 10 minutes. The other three face men, having completed the undercut and drilling, move the face conveyors to within 3 feet of the coal and set a permanent row of props in back of the face conveyor. The mine inspector in the district requires that at no time are we permitted to have props less than 8 feet from the face and all permanent propping must be in rows 6 feet each way. Six holes are drilled about 7 feet apart in a 35-foot face. The corner holes are placed about 14 inches from the rib, 1½ sticks of 1¼-inch permissible powder are used to each hole with a delay detonator. Rock dust is used for tamping. One of the men is responsible for the shooting from a location on the heading.

"After shooting, distributing fan and 12-inch flexible tubing brush the smoke from the face in five minutes. Four men then go to the face and spend about 25 minutes cleaning and gobbing four inches of top slate, which comes down with the coal.

"During the non-coal-loading period, loads have been pulled and a trip of empty mine cars has been placed above conveyor loading point by the locomotive. In loading out a face, and if the mining machine goes from right to left, the right-hand corner is first loaded out. This permits the cutter to sump and start undercutting before the rest of the face is loaded out. When the face is about two-thirds undercut, a man starts to load machine cuttings and set temporary props. The other two men complete the remaining work and drill for shooting.

"These cycles continue until the room is driven 130 feet, when the second cross-cut is started. The first cut in a cross-cut is loaded directly into the main conveyor. One face conveyor is used in connection with loading the second cut and two face conveyors are used to load out the third cut. It takes 15 minutes to replace face conveyors from cross-cut location, back to room face.

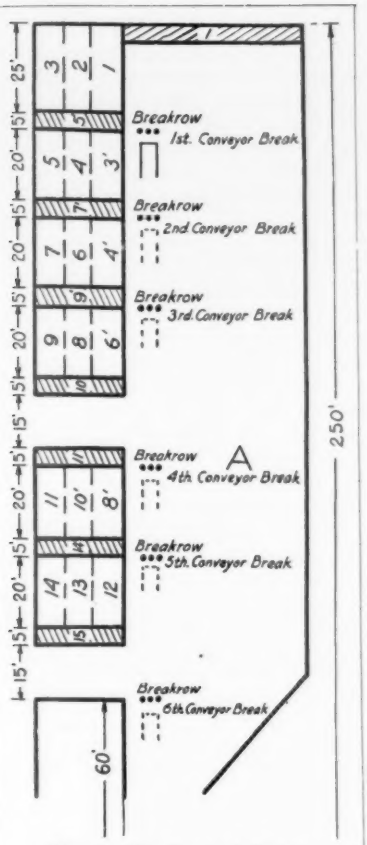


Fig. 1, *Mr. Suppes' Paper*
1 and 2 are loaded out with 1'
3 and 3' together
4 and 4' together
5 and 5' together, etc.

"A room is driven 250 feet long, and on the last cut the mining machine swings around and cuts the first cut out of the rib 25 feet wide. This cut through is completed in three cuts, which are loaded along with the last cut at room face. The balance of the pillar is worked as shown in Figure 1.

"If the roof becomes bad at a point as at 11 and 11', 11 and 11' are undercut and completed, leaving the stump "X" stand 5 feet square. The stump "X" is taken out with pick work after the main conveyor tail end has been reduced 4 pan lengths to a new location as at "A," or this stump may be left in. The cut throughs in the pillar are timbered in the same manner as the face. A double break row of props is set at each location of the tail end of the main conveyor.

"Heading work is being done on a double entry system and headings are being driven 28 feet wide on 80-foot centers. The mine car track is laid through the last cross-cut and connected to the parallel heading track. This gives ample room for mine car supply. A heading face is advanced 250 feet and cross-cuts through the chain pillar are driven half way in. Room necks are driven after face has been advanced to its destination by three of the crew. The other two men break the conveyor, load and transport parts of the conveyor, excess timber, tubing, etc., to the loading point on the heading. The last cross-cut always comes about 25 feet from the face of the heading. This 25-foot cut is sometimes driven narrow and allows room for setting up when it comes time to again advance that face.

"No heading stumps, chain, or barrier pillars have been drawn using conveyors for transportation. However, a plan has been worked out for doing this, and as soon as one unit, now engaged in room work, has completed a section, it will be placed on stump work. How successful the operation will be I can not state definitely, but there is good reason to believe it will be as successful as the other work has been.

"A description of the moving cycle may be of interest. Two men of the five men employed, upon finishing a face, go to the location where the next face is to be driven and shoot a pot out of the roof on the heading supplying head room for the loading boom. This is required where the heading height is less than 5½ feet. The rock from this pot shot runs from three to five, usually three mine cars, which is loaded out. Three men of the crew stay at the first conveyor location and break it into small parts for easy handling. The loading boom or elevating conveyor is first disconnected. The boom weighs 885 pounds and is loaded onto a truck. Controllers and control panel next follow. Motor end of head section, which weighs 975 pounds, is next loaded; pan end of head section, weighing 512 pounds, and tail section, weighing 363 pounds, are next placed on the truck, followed by the intermediate pans, weighing 80 pounds each; 12-foot lengths of chain, weighing 195 pounds each, and the two face conveyors, weighing 510 pounds each, complete with motor. The mining machine trailer and mining machine are pulled on to the heading. The material is then placed at the new location by the locomotive. There the mining machine is first placed. The motor end and head frame are next set up on sights, cable, reel, and trailer, loading boom, tail frame, and an intermediate section are placed. The mine electrician is responsible for setting up the electrical control apparatus and making electricial connections. I might also state, at this time, that he is responsible for lubrication at all times. While the distributing fan, which weighs 87 pounds, and the first 25-foot section of air tubing

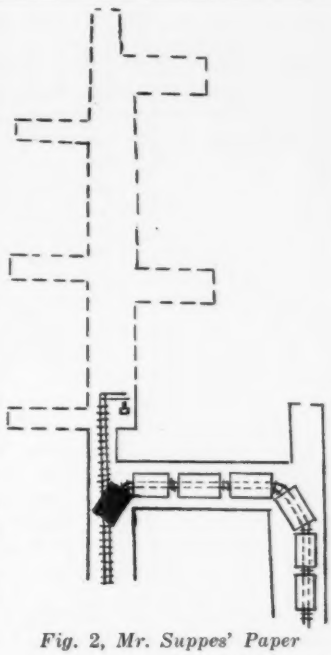


Fig. 2, *Mr. Suppes' Paper*
As soon as one heading is advanced, the equipment is moved to its parallel and two yardage men attend to brushing roof and laying track in the first heading

are being set up along with the face control wire reel, flood light, and battery wire reel, the mine electrician tries out mining machine and main conveyor. The 5 H. P. hoist, which weighs 1,412 pounds, is next moved. This unit, usually, is moved every third face, and is set at the mouth of the room neck below the face being worked. The hoist resistance and control are set remotely and alongside of the conveyor control in order that the operator stationed there may run both the conveyor units and the hoist.

"Following is a summary of the performance at four conveyor faces which have been in operation on the room and pillar system. Unit No. 1-T worked the first 14 faces in 8,560 man hours, loading 17,371 tons of coal, 1,240 tons per face, loaded 16.23 tons of coal, and handled 2.3 tons of top slate per man per eight-hour shift. A face includes all the work of moving, undercutting, drilling, loading shots and shooting, loading coal, handling top slate which comes with coal, timbering; advancing or retreating main conveyor, face conveyors, air tubing, flood light, control and battery wire, and handling all supplies from mine car to face, including props, cap pieces, air tumbing, explosives, and parts of the conveyor itself. The above 14 faces were all new work. Work on the first four faces was paid for on an hourly basis; thereafter all

work has been, in all cases, paid for on a piece-work basis. The first four faces were experimental, and we learned roof conditions would allow a 35-foot room width and an 18-foot pillar, which has since been used in projecting all new work. The next six faces were done in old work and had been driven from 30 feet to 110 feet by old methods, which required retimbering. These rooms were dipping to the face and had been turned off on 40-foot centers. The rooms were continued on the new system 25 feet wide with a 15-foot pillar. The first room and pillar worked out well, the next room was driven to destination, and when the pillar was two-thirds completed a cave came almost without warning. A slip extended across three rooms.

"The mining machine was covered up, or rather cut off, by the fall along with 40 feet of conveyors and two face conveyors. The cost of repairs to the equipment for this mishap is included in costs discussed later; 518 man-hours were spent pulling out the equipment and repairing it. The method of drawing pillars prevented complete destruction of the equipment. The mining machine was removed on its own power and only had a bent clutch handle. Two face conveyors, one of which required some new parts for the motor drive and the other a complete new motor and drive, were removed, and one had to be torn down, straightened out, and rebuilt. The tail end of the main conveyor required straightening and a new bearing. We abandoned 36 feet of conveyor pan and 12 feet of chain. As this material only cost $75 new, it did not pay to reclaim it.

"We learned that on pillar work it is advisable to stop all machinery at certain intervals for three minutes to listen for signs of the working roof. We also learned that it was necessary that all machinery, including as well the drive end of the main conveyor, be quiet in operation, and that a 15-foot pillar was insufficient. However, the balance of the faces in this section were driven 25 feet wide, leaving a 15-foot pillar without further trouble. The men loaded 6,009 tons of coal in 3,992 man-hours; 1,001 tons per face; 12.04 tons of coal per man per shift; 2.3 tons of top slate were also handled per man per shift. The second series of rooms could not maintain the previous average under the conditions. On all 20 places Unit No. 1-T averaged 14.9 tons of coal loaded and 2.3 tons of top slate handled per man per eight-hour shift. The total labor rate was reduced 41.7 percent per ton, and the earnings were 19.6 percent more net wages than the average net wage on the old system.

"Unfortunately, I did not keep the number of hours delay on the first 14 faces, but on the following six faces 720 man-hours delay was caused by

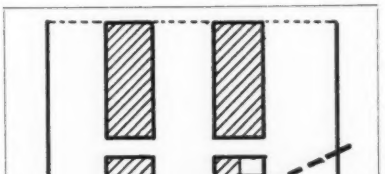


Fig. 3, Mr. Suppes' Paper

main and face conveyor trouble, mining machine trouble, waiting to shift mine cars, cars or locomotive off track, clay vein coal, retimbering bad roof, waiting for a cave on pillar, direct current power trouble, power trouble account service company's line, tipple, cold weather, and railroad car shortage holding up delivery of mine cars to face. (Five hundred and eighteen of these 720 hours were due to disaster on No. 16 face.) Something over 18 percent of the total time spent was lost due to the above incidental delays.

"I believe that the work done by each of the units should be described.

"Unit No. 2-T has worked in all eight faces, of which two were headings and six rooms. Six thousand five hundred and fifty-four man-hours were used doing all the usual work connected with loading 10,365 tons of coal, or 1,296 tons per face and 12.7 tons of coal per man per eight-hour shift. At No. 4 face the men averaged only 7.37 tons each. This was a heading, and on account of bad roof conditions the face was driven narrow, top slate was taken down and permanent timbering done. The work on this face was paid for on the regular rate per ton for loading coal plus the heading yardage rate. Not counting the No. 4 face, the men average 13.27 tons of coal each and 1.4 tons of top slate handled per eight-hour shift. With a 41.7 percent reduction in the tonnage rate, the earnings were 6.9 percent more net wages than the average net wage on the old system. Two hundred and twenty-five man-hours were lost due to incidental delays, which does not include time lost on No. 4 face on account of heading dead work. The incidental delays represent about 3.4 percent of the time spent on the faces. This crew, as a whole, have been unable to coordinate themselves, they are unwilling and inefficient workers, two or three of them have been replaced.

"Unit No. 3-T has completed eight faces, of which five were headings and three rooms. Five thousand four hundred and seven man-hours were used doing all the work connected with loading 10,200 tons of coal; 1,150 tons per face; 15.1 tons of coal loaded; 1.2 tons of top slate handled per man per eight-hour shift. With a 41.7 percent reduction in the tonnage rate, the earnings were 21.6 percent more net wage on the old system. One hundred and eleven man-hours were lost due to the usual incidental delays, something over 2 percent of the total.

"I have given you a summary of the work done by three units, all working at one mine in 42 inches of coal. Thirty-six places were driven and 43,945 tons of coal loaded, 1,220 tons of coal per face or location of units; an average of 13.87 tons of coal loaded per man per shift. Not considering No. 4 face at Unit No. 2-T, where it was necessary to hold up machinery on account of doing heading dead work and timbering, and considering only 35 faces, the crews averaged 14.44 tons of coal loaded and 2.0 tons of top slate handled per man per eight-hour shift.

"Unit No. 1-J has completed 10 faces in the "B" or "Miller" seam of coal, which is exceedingly rolly and runs from 23 to 44 inches in height. Four were in old work and six in new work, all of which were rooms and pillars. Generally, roof conditions were good, although some bad roof had to be taken down and 1 to 2 inches of slate was handled which came with the coal in places. The first three rooms were turned new at 53-foot centers and driven 215 feet to the outcrop. The next four rooms were old works which had been standing, having been laid off at 50-foot centers and driven an average of 115 feet. The balance, three rooms, were turned new at 53-foot centers. Six thousand eight hundred and ninety-eight man-hours were used loading 11,127 tons of coal; 1,113 tons per face and 12.9 tons of coal per man per shift. With a 41.7 percent reduction in the tonnage rate, the earnings were 44.9 percent more net wages than the average net wage on the old system. Two hundred and fifty-six man-hours were lost due to the usual incidental delays, something less than 4 percent of the time spent. The problem of operating this coal had been extremely difficult, and I do not know any other way in which the same could be, at this time, economically worked.

"A resume of the data covering all the work done is interesting.

"Four units have completed, up to April 1, 46 faces, loaded 55,072 tons of coal, 31,408 man-hours have been used and an average of 14.03 tons of coal loaded, 1.74 tons of top slate handled per man per eight-hour shift; 1.75 tons of coal per man-hour; 1,197 tons per place; 1.21 faces per month of total elapsed time have been finished. On the old system, as near as I am able to estimate, we finished .3 of a place per month,

providing it worked steadily, which was not the case by any means.

"In 7 feet of coal, instead of 3½ feet, it would not be out of the way to run 2½ tons of coal per man-hour employed.

"It is worth while looking into the safety experience which we have enjoyed. To date one lost time accident has been suffered, which happened a month after the installation of a unit. A piece of top slate fell on the injured, causing a contusion of the lower right side, which happened while shoveling coal. The injured lost 35 days of work.

"Our most anxious time, from the standpoint of accidents, is after three faces have been completed in a new section and the pillar to the third face is being brought back. When that pillar is about two-thirds completed, the roof works from 6 to 10 hours followed by a high cave. Thereafter the caves occur after finishing each room and pillar and removing the machinery therefrom, and before the next pillar is started.

"In projecting headings it is advisable to consider room length after width of room and size of pillar have been determined, in order, in most cases, to have the cave after completion and removal of machinery from a face. Unit No. 1-J has experienced a cave at each face when the pillar was half way drawn.

"It is only natural that you can expect opposition to anything which may be new in mine machinery and its application to mining. The men, as a whole, who are to operate the machinery and use the new methods are the most opposed to changes; although frequently the origin of an excellent idea or improvement is with one of them. The mine owner, too, is in line for some criticism upon his attitude of letting the other fellow do the experimental work.

"You have all, generally, been hitting costs by getting a large volume. This method has given about all one can expect for the time being, and the next item to attack is that of mining; in other words, the labor rate per ton of coal loaded on board mine car at room entry. The dead-work item, especially in the low-seam mines, is another cost which offers possibilities of improvement. Either or both of these items can be attacked to advantage. There is but one way the problem can be solved, and that is by spending more of the energy wasted at the face in loading coal.

"Concentrated work also lends itself well to supervision. In few words, the tonnage per face man must be increased, and that increase must come with no more and probably less expenditure of physical effort than was previously used. Less energy is used to load a shovel full of coal in a carrier 12 inches high than into one 36 inches high; if it is unnecessary to take even a step and subtract the pitching effort entailed in shoveling and allow good clearance between top of carrier and roof, better efficiency will result. Double shoveling of coal is a very wasteful practice.

"During the loading of 55,072 tons of coal 46 different faces were worked, hence equipment was moved 46 times. This cost 3 cents per ton. Cost of repair parts for conveyor equipment was 1.14 cents per ton. Cost of other machinery parts, including mining machine, fan, hoist, and wiring, etc., 1.41 cents per ton. Cost of power, 1 cent per ton. In connection with this I might say that the conveyor runs 3½ minutes per ton, mining machine runs 1.6 minutes per ton, hoist runs 20 seconds per ton, and fan and flood light run steadily. Explosives and carbide cost 2.49 cents per ton, which may be reduced by purchasing the material in larger quantity. Allowing 25 cents for interest and depreciation on the total investment, we have an actual cost here of 11.53 cents per ton, labor cost of disaster at face No. 16 unit No. 1-T was .55 cents per ton. Taking these costs and adding thereto the labor cost, we find a saving of 25 percent in the cost of coal on board mine car in trips at room entry.

"It is hard to tell what the other savings will be. At one mine where we have three conveyors in operation and are loading less than 40 percent of the normal capacity of the mine, the total dead-work cost has been 8.63 cents per ton for the last eight months. In 1924 we paid 25 cents for dead work on every ton of coal produced at this mine. The dead-work saving has been due to the elimination of all dead work in rooms and the reduced amount of development necessary for concentrated work. Previously we were required to have sufficient development to take care of about five to six times the places we now require.

"It is further difficult to tell what this system will mean in the reduction of mine operating costs, mine maintenance costs, and total mine labor costs. So far there is a pleasing result. When I make a comparison with the costs of six other mines to which I have access and which work under similar operating conditions and on the same labor rates, I find:

"Piece-work labor was 35.3 percent less at the mine operating the conveyor system. Mine operating labor 11.4 percent less at the mine operating the conveyor system. Mine maintenance was 0.3 percent less at the mine operating the conveyor system. And total mine labor, which includes superintendent, engineers and mine office, was 24.4 percent less at the mine operating the conveyor system.

"This comparison is made covering the last eight months to April 1 and during which time three units have been in operation at 'T' mine, along with which tonnage some was mined and paid for on the old method. 'T' mine operated on a 40 percent of normal output, while the other six mines dumped a normal tonnage.

"And now it appears that methods other than hand shoveling into the conveyors can be considered. In the accomplishment of this step the elimination of the mining machine and the use of explosives can be expected."

MINING PLANS FOR DIFFERENT TYPES OF CONVEYORS

***HEBE : DENMAN**, President, Paris Purity Coal Co., Clarksville, Ark.:*

"My experience with conveyors has been gained in the thin coal long wall field of Paris, Ark., where we mine a domestic coal.

"We have been operating with conveyors somewhat over three years, and we do not consider conveyors any longer an experiment. More than three-fourths of the coal we produce ourselves and more than half the coal of the Paris field is mined by the use of conveyors. It is our way of earning a living, it isn't an experiment—but an established system of mining with us.

"My experience with underground conveyors in mining has been entirely with panel long wall work, and in writing this paper I have confined myself entirely to the use of conveyors with this system of mining, not considering the use of conveyors in room and pillar work.

"With few exceptions, the different type of conveyors can be used with all the different panel long wall plans used with the conveyor system of mining.

"The factors that determine the type of conveyor are not the mining plans or system but the characteristic of the coal vein, such as the thickness of the vein, pitch of bed, and nature of the roof and bottom. Even wide variations in these characteristics do not call for different types of conveyors so much as suiting the details of construction of any type to the height of the vein, pitch, etc.

"In speaking of the different types of conveyors, the types that I have in mind may be roughly classed as follows:

"First: One where the coal is transported in a stationary trough either carried by a belt or carried or pushed by the flights of a chain or chains, termed belt and chain conveyors.

"Second: One where the coal is propelled in a sliding motion along a metallic trough by the jigging or reciprocating motion of the trough itself—jigging conveyors.

"Third: Where no trough is used, but the coal is carried in flat pans or even small flat cars attached to a reversible endless rope or a tail rope system which pulls the pans along the wall. The pans are loaded by the loaders along the wall, moved by the rope to the roadway where the pans or flat cars are automatically

loaded into the pit cars. The scraper-loaders might be properly termed conveyors of this class though they perform more functions, such as automatic loading, conveying, and dumping.

"Now most any one of these types of conveyors can be used on any of the commonly used panel long wall plans.

Pitch of Vein

"Where the walls or panels are arranged so that it is necessary to transport the coal upgrade, the chain type of conveyor has a wider range of operation than the other types. In other words, it can successfully transport the coal up steeper grades than any of the other trough conveyors. Where the walls are arranged so that the coal is transported level or down hill, any type can be successful to a grade where the coal will roll or slide on a smooth metallic surface and then gravity chutes can be used.

Roof Conditions

"We only need consider bad roof conditions. With bad roof, one that has lots of slips, is tender and brittle, and requires much timbering close to the face, the type of conveyor must be narrow and occupy little space to operate. In this kind of roof where it is necessary to prop between the conveyor and the coal face, and the props or other roof supports can not be temporarily removed to move forward the conveyor as a whole, a sectional conveyor that can be quickly separated into sections, quickly moved forward and quickly reassembled and put in operation is required.

"The belt conveyor will not meet these conditions; the chain conveyor can not be quickly sectionalized, moved, and reassembled. The jigging type of conveyor most nearly meets this condition.

"The moving of the conveyor is an important part of the work and excessive time needed for doing it may mean failure of the conveyor system.

"In my opinion, where the roof is so bad that the conveyor must be sectionalized to move it forward, the use of conveyors at all is a very doubtful proposition and can only succeed with other conditions exceedingly favorable.

"For successful operation, three hours would seem about the maximum length of time required to complete the operation of moving the conveyor and putting it in operation. To be a success, I consider that the conveyor should be moved up, generally speaking, one cut every day of 24 hours.

"In our mine using conveyors, we have four of the heavy double chain type of conveyors in use. The loaders on the wall move the conveyors on the day shift after loading out the cut of coal. It takes, to move, realign, and put the conveyor in condition for operation, from 40 minutes to two hours time. The conveyor is moved forward as a whole without disconnection, with "Sylat" post pullers, one loader to each puller, and about six to eight pullers are used to move forward the conveyor.

Height of Vein

"Any of the common types of conveyor can be used in most any vein now being worked. In working low veins, say 18 to 28 inches thick, like ours at Paris, Ark., the different types can be used, but the conveyor should be so designed that the over-all height will not exceed 7½ inches.

Character of Coal and Markets

"The market and nature of coal must be considered carefully in choosing the type and especially the design of the conveyors. Our market was entirely for a domestic lump coal and the mines in our field are only operated for the domestic trade. For years the mines had been operated on the long wall plan and the loaders were paid for hand-picked coal (coal loaded by hand without a shovel, leaving the slack and fine coal inside). However, practically all the coal was machine mined and came out in chunks, with practically no slack.

"Our problem was to design a conveyor that would transport the coal along the wall to the roadway, a maximum distance of 300 feet, and load it into the pit cars with the least possible degredation, in a vein averaging 24 inches thick. The thought was that the coal must be carried and not dragged. The chunks came out the full thickness of the coal vein, and many of them weighing over 200 pounds. That and the low height seemed to preclude belt conveyors.

"Finally Mr. Claghorn designed for us a chain type of conveyor, 7 inches high over all, with two strands of chain that carried the coal on the top of the chain instead of dragging it. That solved this phase of our problem.

"Where the coal is soft and the slack is loaded with the lumps, if a chain conveyor is used the design should take care of the tendency for the slack and small coal to accumulate under the chain, causing the chain to ride and sometimes to climb out of the conveyor trough. At some places this has given serious inconvenience and trouble.

Top or Bottom Brushing in Roadways

"In veins where brushing must be taken to load the coal from the conveyor over the top of the pit cars, the design of the conveyor must be suited to the kind of brushing to be taken. This, however, does not affect the type of conveyor, but only the design and details of the conveyor.

"When the bottom is lifted in the roadways so that the top of the cars come below the level of the bottom of the coal vein, then the simplest and cheapest design of conveyor can be used. Lifting bottom, or bottom brushing, is more expensive than roof brushing, and probably in the large number of mines the bottom can only be lifted with great difficulty. In this connection there is no doubt but that the bottom can be lifted fairly cheaply with Jackhammer drills at many places where it is thought out of the question to brush the bottom. We found this out from our own experience.

"Where the roof is brushed, the design of the conveyor must meet this condition or some auxiliary apparatus used to elevate the coal and load it into the pit cars.

Mining Plans

"Generally speaking, the mining plans usually used with conveyors can be divided into two classes. The 'V' or saw-tooth walls, with short faces 75 to 150 feet long, and the long straight walls with faces 150 to 350 feet long.

"The main idea of the first plan being to break the roof along a line of the outside points of the saw, and that the breaks will not extend into the recesses or points of the 'V.'

"With the long straight face plan, the idea is either to break the roof along certain definite straight lines, allowing it to cave back of the face or gradually allow the roof to settle with little or no break of the roof or compressible supports, such as cribs and pack walls in the worked-out area.

"Any of the above-mentioned types of conveyors can be used with either plan.

"These mining plans can be further classified as follows: Panel long wall face advancing; panel long wall face retreating.

"My understanding of the title of the subject assigned to me, 'Mining Plans for Different Types of Conveyors,' does not contemplate my entering into a discussion of the relative merits or demerits of either of these systems.

"Although it is not included in my subject, I will take the liberty to briefly mention a simple mining plan for conveyors used at Paris, Ark.

"We introduced conveyors into that field about three years ago and have operated them since that time. Now there are about 15 or 20 conveyors in use, and more than half the output of the field is produced with the aid of conveyors.

"The plan developed is a simple advancing plan requiring little preliminary development and little narrow work driven in advance of the wall. This plan is best suited to good roof conditions where the bottom can be easily lifted.

"For example, take three panels, each with a conveyor 250 feet to 300 feet long. The only two roadways driven in the solid in advance of the walls for a series of panels may be a slope or main entry, and an entry driven in the solid and kept in advance of the face of the first panel started about 60 to 75 feet. It is in-

tended that panels should be turned on both sides of the slope or entry.

"The long wall panels are turned directly off the slope without any protecting pillars of coal, the only precautions for the protection of the slope roadway being cribs on each side and sufficient bottom bracing to leave plenty of head room after a settlement of about 59 to 75 percent of the height of the coal vein.

"Following the first panel on the left side is a brushed roadway following after the wall. This helps ventilation and acts as the loading road for the next panel following. One panel face should be kept far enough behind the preceding one so that a break on the first wall does not extend to the following wall. This interval or space should be at least 150 feet, with 250-300-foot faces. The breaks of the roof only extend into the corners about every third break—the other breaks being roughly in circular form.

"In this plan the roadways are protected by cribs and pack walls and the working faces maintained, either with cast iron sand props to break the roof or along the line of the face without any supports back of the worked-out area, or by cribs and heavy props along the wall and back in the worked-out area to allow the roof to gradually settle down with as little disturbance as possible.

"To sum up the matter in regard to mining plans for different types of conveyors: Successful mechanical work of conveyors is no longer in doubt. It is only necessary to pick the type, and especially the design to suit the coal vein and the surrounding conditions.

"In regard to the mining conditions. The first consideration is a plan that figures a profit over the other system. Some plans might work but show no profit. The next consideration is a system that can be successfully maintained and continued. That means successful roof control. The main problem in all these plans.

"My subject does not cover this very important phase of mining, and I do not want to infringe on the subject assigned to several other members; but I am going to take the liberty of briefly stating our progress along this line, covering about three years of operation with conveyors.

"Of the two general plans of handling the roof, one to support the roof on pack walls and cribs and let it gradually settle down with as few breaks as possible; another the caving system, using a line of strong supports just back from the face of the coal to break the roof along a definite straight line and not maintain any timbering or pack walls back of the face. We decided that the caving or breaking plan was best suited to our conditions.

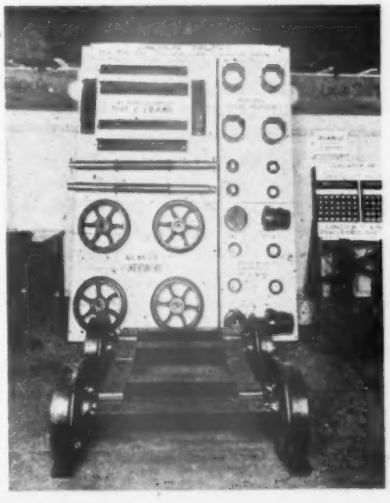
"In order to do this it was necessary to devise some rigid support that would not give or settle but would cause a definite line of fracture. Concrete blocks appealed to us, but we found that these often split under pressure and it was almost impossible to move them after the weight came on. Cast-iron props looked like the right thing to use, but they were too expensive to leave in the gob, and we did not want to support the roof far back of the wall, and there seemed no way to remove them once the full weight of the roof came on them.

"Finally, Mr. R. C. Johnson, the treasurer and manager of the Paris Purity Coal Co., solved this difficulty by designing a cast iron sand prop which had great strength and yet could be easily moved forward after the full weight of the roof had settled on them. These props have been in use for over a year and have proven successful in all particulars, with one exception of considerable breakage of the metal props due to careening of the props caused by the uneven bottom.

"These props are made from a cast-iron alloy having about twice the strength of common cast iron, and we estimate each of these props will stand a vertical pressure up to about 300 tons. These props are made for us by the Engineering Works, of Van Buren, Ark."

GEORGIA CLAYS

GEORGIA clays, properly mined, refined and blended, can be utilized in the manufacture of chinaware, tiling, high-grade refractories, and face brick, and can be used to displace to some extent imported clays, according to the Bureau of Mines, which has finished a technical study of these clays, in cooperation with the Central of Georgia Railway. The State of Georgia contains large areas of sedimentary kaolins and bauxites of industrial importance. Considerable development has taken place, and many undeveloped deposits are available.



Georgia kaolins have heretofore been used to some extent in the several whiteware industries. They have been used in virtually every type of pottery body, both dry press and plastic, where a china clay is required. In some cases they have been used successfully, while in others their use has been discontinued because of various reasons more or less warranted. Their use has been abandoned by some chinaware manufacturers principally because of lack of uniformity. Many of the clays burn to a good white, while others burn to a cream color. Georgia clays have been used extensively in the sanitary tile and electrical porcelain industries, but some manufacturers of these wares have not made use of them because black specks developed during the firing.

The Bureau of Mines investigators found that, by the use of proper washing methods, the Georgia clays can be washed free from material that causes dark specks in white ware. It was found that many clays which burned to an undesirable cream color could be produced white enough to meet requirements if the proper care were taken in their mining and refining. A serious problem in connection with the use of sedimentary clays in white ware is the high bisque loss and excessive shrinkage. These difficulties can, the bureau found, be largely overcome by proper body mixes and by the blending of the clays.

Georgia contains large deposits of refractory clays suitable for the manufacture of high-grade refractories. If enough of the clay is fired to a high temperature and used as a grog, the brick will go through the process of manufacture readily and will withstand every laboratory test for a high-grade refractory.

These findings are of real industrial importance in view of the fact that supplies of the best fire clays of Pennsylvania, Maryland, Ohio and Kentucky within reach of the railroads are decreasing, and the average quality of the fire-clay refractories classed as No. 1 has fallen off within the last 15 to 20 years. It must, of course, be recognized that there are fire-clay refractories on the market at the present time as good as any in the past, but the bulk of such, as a class, has evidently decreased in refractories.

Details of this investigation are contained in Bureau of Mines Bulletin 252, "Beneficiation and Utilization of Georgia Clays," by R. T. Stull and G. A. Bole, copies of which may be obtained from the Superintendent of Documents, Washington, D. C., at a price of 20 cents.

LEGISLATIVE REVIEW

Congress Detained By Pressing Measures—Early Adjournment Is Blocked By Important Bills—Coal Legislation Slated For Consideration—Potash Survey Legislation Nearing Enactment—War Minerals Relief Pressed—Many Mining Bills In Legislative Jam

EARLY plans of congressional leaders to close the present session in May received a setback when House and Senate committees began to pour into the legislative hopper important bills which demanded immediate consideration. While the major legislative program, which included the tax revision bill, had been handily disposed of in order to permit of early adjournment, these other legislative proposals were of so pressing importance and demanded prompt consideration that Congress decided to remain on the job and clean up as many as possible of the mass of bills which had received committee sanction. At one time it had been considered advisable to put off consideration of the legislation for voluntary mediation of railroad labor disputes. This bill had passed the House earlier in the session and had been reported by the Senate committee. Pressure for the measure resulted in its passage by the Senate after a week's debate.

Legislation affecting the coal industry appears possible of enactment, notwithstanding previous indications that Congress would not touch this subject at this session. The House Committee on Interstate Commerce conducted hearings on proposed coal legislation over a period of six weeks and is considering legislation introduced by its chairman. In the Senate, the Committee on Labor, without holding hearings, reported a bill designed to meet future emergencies in the coal supply. The pending bills create the Bureau of Mines as a fact-finding agency with authority to secure data bearing on all phases of the coal industry. It is provided that in case the miners and operators can not agree on wages or other questions affecting operation of the mines, that the President shall appoint mediation agencies, either existing or new, to aid in solving the problem. In case of interruption of coal supply, the President is authorized to put into effect the law of 1922 to control distribution and regulate prices through a Federal fuel distributor and priority orders of the Interstate Commerce Commission.

A number of mining bills are making progress toward enactment. The Senate passed a bill broadening the war-mineral relief act by authorizing the payment of claims of producers for losses in connection with the purchase or lease of property and for interest on borrowed money. This bill is being considered by the House Committee on Mines and Mining, where it has been urged by representatives of producers but opposed by the Secretary of the Interior.

A bill has been passed by the Senate and is pending in the House on report of the Mines and Mining Committee looking to surveys and laboratory tests by the Geological Survey and Bureau of Mines of potash resources. A law was passed authorizing prospecting permits and leases for sulphur in Louisiana. Another law authorizes mining leases on Indian agency and school lands, while another enactment permits three holdings of 2,560 acres each in a state under mineral leases.

The House Committee on Mines and Mining has taken no further steps regarding legislation concerning prevention of mining accidents which was considered in hearings on bills to establish additional mine rescue stations. It is expected this matter will be allowed to go over until next session, when attempt will be made to secure additional appropriations for mine rescue and safety investigations by the Bureau of Mines. In the meantime, additional bills are being introduced to establish new mine rescue stations, the latest having been presented by Senator Ernst, of Kentucky, who proposes to locate a station at Hazard, Ky.

The question of state or Government ownership of minerals in lands granted to the states by the Government for school purposes has been considered in connection with more than a dozen measures introduced on the subject. Some of these bills turn over the lands and their contents outright to the states, while others give the land to the states but reserve the minerals to the Government. The Interior Department has opposed hasty action along this line, pointing out that the present system of administering these lands has been satisfactory for more than 50 years, to the benefit of the miner and the prospector who has to deal with only one agency—the Government. It is declared that if the states are given the right to lease the minerals in these lands that confusion will result because of the different manner in which the states may legislate as to the conditions under which the lands may be leased.

Legislation designed to simplify administration of affairs in Alaska has been passed by the Senate under which commissioners will be designated for the Departments of Interior, Commerce, and Agriculture to administer affairs in Alaska.

The silver purchase bill is not making headway. This measure, authorizing the purchase of 14,000,000 ounces of silver at $1 per ounce, has been on the Senate calendar all winter on report from the Banking Committee. It has come up in the Senate a number of times during consideration of unobjected bills on the calendar, but each time some Senator has objected and action on it is blocked. The only other way by which the measure can receive consideration is on a motion to consider the bill, which would try out the strength of the opposition, which appears to exist on both sides of the Chamber.

The possibility of power development for mining purposes in the Colorado River region is growing. The Senate Irrigation Committee reported a bill to carry out this project under a bond issue of $125,000,000 at 4 percent, and the House committee is trying to reach a vote on a similar measure. There is a proposal, however, that pending action by Congress on this project the Interior Department shall investigate and report at the next session as to the possibility of leasing water power so developed.

After more than six years consideration of the question by Government agencies and Congress, the Muscle Shoals lease project has narrowed down to a proposition of leasing this property to the Muscle Shoals Fertilizer and Power Distributing Companies. This action has been recommended by the congressional commission which investigated the subject this spring, but Congress is not expected to take up the matter looking to its final disposition until the next session of Congress.

The following is a summary of action on bills during the month:

Coal Bills

S. 4177. Introduced by Mr. Copeland (Dem., N. Y.). Reported by the Committee on Labor. This bill proposed "to regulate interstate and foreign commerce in coal and to promote the general welfare dependent on the use of coal." It authorizes the Bureau of Mines to gather, analyze, and publish all essential facts and conditions of production, distribution, and storage of coal, including costs, prices, profits, marketing, wages, working conditions, intercorporate relations, trade and labor agreements, and practices, ownership, royalties, and all other factors affecting the operation of the

coal industry for consideration in the determination of a sound public policy in regard to the industry. The bill authorizes the bureau to have access to and the right to copy any book, account, record, paper or correspondence relating to any matter which it is authorized to investigate.

Title 2 of the bill seeks to regulate labor relations, by providing as follows:

"It shall be the duty of all employers and employes engaged in the coal industry to exert every reasonable effort to make and maintain agreements concerning wages and working conditions. * * *

"In the event that a dispute between employer and employe or employers and employes is not settled through such machinery of contact and adjustment as they may mutually establish, the President is authorized, in his discretion, to employ such officers, agents, or agencies as may exist or as he may create suitable for that purpose to mediate in such dispute, and, if unable to bring the parties into agreement, to endeavor to induce them to submit the controversy by voluntary agreement to the decision of arbitrators.

"In the event that any dispute or disputes not settled in the manner heretofore provided shall threaten substantially to restrain or to interrupt interstate commerce, the President is authorized and empowered to create an Emergency Coal Board.

"The said board shall investigate and report to the President upon the controversy within 30 days of the date of its creation and shall report specifically as to whether, if the controversy in question remains unsettled, the result will be to deprive the public of an adequate supply of coal, or otherwise substantially to restrain or interrupt interstate commerce."

The bill authorizes the President to declare an emergency if the board reports restraint or interruption in interstate commerce in coal, or an inadequate supply. In such emergency the President is empowered to bring into effect the law of 1922, establishing a Federal fuel distributor and permitting the Interstate Commerce Commission to issue car service priorities to prevent the sale of fuel at unjust and unreasonably high prices.

H. R. 11898. Introduced by Mr. Jacobstein (Dem., N. Y.). Referred to the Committee on Interstate Commerce. This is similar to the foregoing, and in addition authorizes the President, in an emergency, to operate or lease any and all coal properties.

H. R. 12209. Introduced by Mr. Parker (Rep., N. Y.). Referred to Committee on Interstate Commerce. This bill is designed "to protect the Government and the public from shortages of coal," and authorizes the Bureau of Mines to collect and issue data regarding all phases of the coal industry similar to that provided in the Copeland bill. The bill provides a fine of $5,000 or one year imprisonment, or both, for refusal to report to the bureau. The bureau is authorized to secure information and statistics from the Geological Survey, Interior Department, Census Bureau, and other Government departments. This information is to be available to the Interstate Commerce Commission for use under paragraph 15 of section 1 of the commerce act.

When the President finds it necessary to preserve or restore industrial peace in the coal industry, he may direct the Secretary of Labor to conciliate differences, encourage arbitration or to act as mediator; or appoint one or more persons to act as mediators; or establish temporary boards of mediation.

To protect against shortages or possible shortages of coal by reason of a lockout or strike or the possibility of such stoppage which affects a substantial decrease in the production of coal, the President is empowered to proclaim an emergency and to put into effect the Federal fuel distribution and car priority law of 1922. The bill is based on the following principle: "To protect the Government and its agencies, the instrumentalities of interstate or foreign commerce, and the public from shortages of coal, and to have adequate and necessary facts available, in the event of an emergency, for the immediate enactment of such further legislation as Congress may deem advisable and for the proper execution of existing law."

IMPORTANT BILLS REVIEWED IN THIS ISSUE

Coal

S. 4177—Copeland (Dem., N. Y.). Coal Regulation.
H. R. 11898—Jacobstein (Dem., N. Y.). Coal Regulation.
H. R. 12209—Parker (Rep., N. Y.). Coal Regulation.

Mining

S. 3641—Passed by Senate. War Mineral Relief.
S. 1821—Passed by Senate. Potash Survey.
S. 3186—Enacted into law. Louisiana Sulphur.
H. R. 7752.—Enacted into law. Mining Leases.
H. R. 7372.—Enacted into law. Lease Holdings.
S. 4157—Ernst (Rep., Ky.). Mine Station.
S. 564—Passed by Senate. State Land Title.
H. R. 11889—Sinnott (Rep., Oreg.). Mineral Leases by States.
S. J. Res. 96—Stanfield (Rep., Oreg.). Oil Leases.

Coinage

H. R. 8306—Passed by House and Senate. Silver Coinage.

Industry

H. R. 11886—Rathbone (Rep., Ill.). Labor Safety.
H. R. 9463—Passed by House and Senate. Railroad Labor.
H. R. 11212—Parker (Rep., N. Y.). Railroad Consolidation.
S. 951—Passed by Senate. Steel Cars.
H. R. 11944—Berger (Soc., Wis.). Government Rail Ownership.

Power

S. 3331—Reported by Committee. Colorado River.
H. Res. 245—Leatherwood (Rep., Utah). Power Lease.
S. 4106—Deneen (Rep., Ill.). Muscle Shoals.
S. 2516—Passed by Senate. Forest Experiment Station.
H. R. 8653—Reported by Committee. Convict Labor.
H. R. 12171—McSwain (Dem., S. C.). Plant Closing.
S. J. Res. 107—Gillett (Rep., Mass.). Commodity Units.
H. R. 11351—Berger (Soc., Wis.). Mob Violence.
H. R. 11420—Berger (Soc., Wis.). Free Speech.

War Mineral Relief

S. 3641. Introduced by Mr. Oddie. Passed by the Senate. This bill amends the war mineral relief act by authorizing the payment of losses in connection with the purchase or lease of property and for interest on borrowed capital. It also authorizes appeals from decisions of the Interior Department under the act to the Court of Claims.

Potash Survey

S. 1821. Introduced by Mr. Sheppard (Dem., Tex.). Reported by the House Committee on Mines and Mining. This bill authorizes an appropriation of $100,000 for each of the next five years for investigations by the Geological Survey and Bureau of Mines to determine the location and extent of potash deposits in the United States and for laboratory tests of potash. As passed by the Senate it carried an appropriation of $550,000 per year for five years, but the appropriation was reduced by the House committee.

Sulphur Leases

S. 3186. Introduced by Mr. Ransdell (Dem., La.). Enacted into law. This law authorizes prospecting permits and

leases for sulphur on public lands in Louisiana. The permits would be for two years for 640-acre tracts. The leaseholder would be required to pay the Government a royalty of 5 percent of the quantity or gross value of the sulphur at the point of shipment. Lands known to contain sulphur would be leased at a royalty to be fixed by the Interior Department and the payment of an advance rental of 50 cents per acre per annum.

Mine Leases

H. R. 7752. Enacted into law. This law authorizes mining leases on land reserved for Indian agency and school purposes, upon a one-eighth royalty payment.

H. R. 7372. Enacted into law. This law amends the leasing law by basing leases thereunder on the amount of lands and not the number of leases. It authorizes three holdings of 2,560 acres each in a state.

S. 4157. Introduced by Mr. Ernst (Rep., Ky.). Referred to the Committee on Mines and Mining. This bill authorizes the establishment of a mine rescue station at Hazard, Ky.

Land Grants

S. 4143. Introduced by Mr. Cameron (Rep., Ariz.). Referred to the Committee on Public Lands. This bill grants 500,000 acres of public lands in Arizona to that state, the proceeds of which shall be devoted to the care and medical treatment of disabled miners and their dependents.

S. 564. Introduced by Mr. Jones (Dem., N. Mex.). Passed by the Senate. This bill confirms in the states title to lands granted by the Government to them in aid of common or public schools.

H. R. 11512. Introduced by Mr. Sinnott (Rep., Oreg.), by request of the Interior Department. Referred to the Committee on Public Lands. This bill perfects title to public lands granted to the states. The bill reserves minerals in the lands to the Government, with the right to prospect and lease the same. This would not apply to lands containing metalliferous minerals nor to lands withdrawn by the Government on account of their mineral deposits.

S. 4055. Passed by the Senate and reported by the House Committee on Public Lands. This bill authorizes patents to 160-acre tracts of land in New Mexico which have been held for more than 20 years under claim or color of title.

H. R. 11895. Introduced by Mr. Colton (Rep., Utah). Referred to the Committee on Public Lands. This bill confirms in the states title to school land grants and limits the time in which proceedings to exclude them because of their mineral content may be filed. The lands are to go to the states with a reservation of their minerals to the Government, which may grant prospecting and mining rights. Persons who have obtained land from the state shall have a preference right to lease it. The bill does not apply to lands containing metalliferous minerals or lands reserved by the Government for mineral deposits.

H. R. 11889. Introduced by Mr. Sinnott (Rep., Oreg.). Referred to the Committee on Public Lands. This is similar to the foregoing, except that it provides that the states shall lease the minerals. The bill excludes land reserved by the Government for national purposes.

H. R. 11890. Introduced by Mr. Sinnott (Rep., Oreg.). Referred to the Committee on Public Lands. This bill is similar to the foregoing, except that it applies to coal and other minerals.

H. R. 11978. Introduced by Mr. LaGuardia (Soc., N. Y.). Referred to the Committee on Public Lands. This bill is similar to the foregoing, except that it reserves to the Government the mineral rights in the land and authorizes the Government to issue permits for prospecting and mining and preferential rights to lease mineral deposits.

H. R. 12015. Introduced by Mr. Morrow (Dem., N. Mex.). Referred to the Committee on Public Lands. This bill amends railroad land grants by excluding iron and coal from mineral designation thereunder.

S. J. Res. 46. Passed by the Senate and reported by the House Public Lands Committee. This resolution provides that receipts from school lands in New Mexico shall be equally divided among the educational institutions of the state.

S. 2716. Passed by the Senate. This bill authorizes the Interior Department to collect a 3 percent fee from royalties on production under mining leases on restricted Indian lands to be used for supervision, development, and operation of leases.

Indian Leases

H. R. 8185. Passed by the House and reported by the Senate Indian Committee. This bill provides for 10-year mining leases on lands of the Crow Indians in Montana.

H. R. 8313. Reported by the Senate Indian Committee. This bill provides for similar leases.

H. R. 9558. Reported by the Senate Indian Committee. This bill authorizes mining leases on the Tongue River or Northern Cheyenne Indian Reservation, Montana.

H. R. 11849. Introduced by Mr. Sutherland (Rep., Alaska). Referred to the Committee on Public Lands. This bill authorizes grazing districts in Alaska, which, however, shall be subordinated to the development of the mineral and water resources of the land.

S. 3928. Introduced by Mr. Willis (Rep., Ohio). Passed by the Senate. This bill authorizes the appointment by the Interior, Agricultural, and Commerce Departments of a commissioner for Alaska to administer affairs in that territory.

S. 4152. Introduced by Mr. Cameron (Rep., Ariz.). Reported by the Committee on Indian Affairs. This bill authorizes oil and gas mining leases on unallotted lands in executive order Indian Reservations. Mr. Bratton (Dem., N. Mex.) introduced a substitute for this bill.

S. 4054. Introduced by Mr. Jones (Dem., N. Mex.). Referred to the Committee on Public Lands. This bill extends the oil leasing act to the Zuni District of the Manzano National Forest, New Mexico.

H. R. 11614. Introduced by Mr. McClintic (Dem., Okla.). Referred to the Committee on Public Lands. This bill makes available for flood control in Oklahoma the proceeds from oil wells in the Red River region to which there are no legal claimants.

S. 4107. Introduced by Mr. Harreld (Rep., Okla.). Referred to the Committee on Public Lands. This is similar to the foregoing.

Oil Lease

S. J. Res. 96. Introduced by Mr. Stanfield (Rep., Oreg.). Reported by the Committee on Public Lands. This gives placer mining claimants in the Red River oil region who were ruled out by the court a 90-day preference right to a lease for 320 acres.

Silver Purchase

S. 756. Mr. Phipps (Rep., Colo.) introduced an amendment to this bill, which authorizes the purchase of 14,000,000 ounces of silver at $1 per ounce, to provide that this and other silver purchased under the original law shall be coined into standard silver dollars, and for repeal of the original act.

H. R. 8306. Passed by the House and Senate. This bill authorizes the coinage of 6,000,000 50-cent pieces in memory of those who went over the Oregon Trail.

S. 4018. Passed by the Senate, but rejected by the House. This bill proposed to authorize the Philadelphia Mint to coin, without expense, 500,000 medals to be sold for the purpose of preserving the birthplace of Henry W. Longfellow.

H. J. Res. 230. Passed by the House. This bill authorizes the Philadelphia Mint to demonstrate on a stamping press the process of producing coins, at the South Jersey Exposition to be held at Camden, N. J., in July, August, and September.

Labor Safety

H. R. 11886. Introduced by Mr. Rathbone (Rep., Ill.). Referred to the Committee on Labor. This bill establishes a safety division in the Bureau of Labor Statistics of the Department of Labor.

Railroad Labor

H. R. 9463. Passed by the House and Senate. This is the new railroad labor

dispute adjustment legislation, replacing the Railroad Labor Board, with regional and other boards of mediation.

H. R. 11212. Introduced by Mr. Parker (Rep., N. Y.). Referred to the Committee on Interstate Commerce. This bill provides for consolidation of railroads.

H. R. 6573. Enacted into law. This law extends the time in which the Alaska Anthracite Railroad shall complete its lines in that territory.

GOVERNMENT OWNERSHIP

H. R. 11944. Introduced by Mr. Berger (Soc., Wis.). Referred to the Committee on Interstate Commerce. This bill provides for Government ownership and operation of the railroad, telegraph, telephone, and express systems, under a Department of Transportation and Telegraph. The bill provides for a commission of 12 persons to value these properties, which shall be purchased by the Government under 4 percent bonds.

S. 4110. Introduced by Mr. Trammell (Dem., Fla.). Referred to the Committee on Interstate Commerce. This bill provides that the Interstate Commerce Commission shall give shippers 60 days notice of proposed increased freight, express, and passenger rates.

RAIL BILLS

S. 750. Passed by the Senate. This bill requires railroads to secure permission of the states and the Interstate Commerce Commission to construct new lines or abandon lines of railroads.

S. 1344. Reported by the Committee on Interstate Commerce. This bill extends the existing liability of the initial carrying railroad for loss or damage to property handled by two or more railroads, to cases where the final destination has been changed by the shipper while the property is being shipped.

S. Res. 207. Introduced by Mr. Shipstead (F. L., Minn.). Referred to the Committee on Interstate Commerce. This resolution provides for an investigation of a strike on the Western Maryland Railroad, a coal carrier.

POWER DEVELOPMENT

S. 3331. Introduced by Mr. Johnson (Rep., Calif.). Reported by the Committee on Irrigation. This is the Colorado River electrical development bill, under which the Boulder Canyon Dam would be built under a bond issue of $125,000,000 at 4 percent.

H. Res. 245. Introduced by Mr. Leatherwood (Rep., Utah. Referred to the Committee on Irrigation. This resolution asks the Interior Department to ascertain and submit to Congress at the next session proposals for leasing water power on the Colorado River.

MUSCLE SHOALS

S. 4106. Reported by Mr. Deneen (Rep., Ill.) from the Muscle Shoals Special Committee. This bill proposes to lease the Muscle Shoals, Ala., nitrate and power properties to the Muscle Shoals Fertilizer and Power Distributing Companies. Mr. Heflin (Dem., Ala.) introduced a substitute to lease the project to the Air Nitrates Corporation, and the American Cyanamid Company.

H. R. 11602. Reported by Mr. Morin (Rep., Pa.). from the Muscle Shoals Special Committee. This is similar to Mr. Deneen's bill.

S. 4005. Introduced by Mr. Willis (Rep., Ohio). Referred to the Committee on Territories. This bill provides a form of government for the Virgin Islands, giving the Government control over the mines and minerals for the public benefit.

FOREST STATIONS

S. 2516. Passed by the Senate. This bill establishes at a cost of $30,000 a forest experiment station in Pennsylvania or neighboring states.

H. R. 11605. Introduced by Mr. Aswell (Dem., La.). Referred to the Committee on Agriculture. This bill appropriates $85,000 to establish a hardwood forest experiment station near Colfax, La.

CONVICT LABOR

H. R. 8653. Reported by the Committee on Labor. This bill subjects goods mined or produced by convicts or prisoners to the laws of the states in which they may be placed for consumption.

H. R. 12171. Introduced by Mr. McSwain (Dem., S. C.). Referred to the Committee on Interstate Commerce. This bill requires manufacturers to notify the Federal Trade Commission of their intention to close their plants.

TRADE PROMOTION

H. R. 3858. Passed by the House and reported by the Senate Committee on Commerce. This bill creates an organic act for the work of the Bureau of Foreign and Domestic Commerce which has heretofore been conducted under annual appropriations by Congress.

H. R. 11383. Introduced by Mr. Lineberger (Rep., Calif.). Referred to the Committee on Interstate Commerce. This bill establishes a district office of the Bureau of Foreign and Domestic Commerce at Los Angeles.

S. 4021. Introduced by Mr. Shortridge (Rep., Calif.). Referred to the Committee on Commerce. This is similar to the foregoing.

COMMODITY UNITIES

S. J. Res. 107. Introduced by Mr. Gillett (Rep., Mass.). Referred to the Committee on Commerce. This bill authorizes the Department of Commerce to establish commodity quantity units for merchandising use after 1935, standardizing the yard to the meter, the quart to the liter, and the pound to 500 grams decimally divided.

MOB VIOLENCE

H. R. 11351. Introduced by Mr. Berger (Soc., Wis.). Referred to the Judiciary Committee. This bill proposes to punish state and municipal officers who fail to protect persons from mob attack, and to punish those who participate in such attacks.

H. R. 11420. Introduced by Mr. Berger (Soc., Wis.). Referred to the Judiciary Committee. This bill seeks to prevent interference of the right of free speech or assembly.

H. R. 10312. Passed by the House. This bill authorizes the disposition of the Frenchman's Bay, Me., coal depot, no longer needed for naval purposes.

INTERNATIONAL COAL CONFERENCE

AN international conference on coal will be held at the Carnegie Institute of Technology, in Pittsburgh, the end of November, 1926, according to an announcement of plans now being devised by Dr. Thomas S. Baker, president of the Institution. The fundamental idea of the meeting, it is announced, is the discussion of new uses of bituminous coal.

Several prominent scientists of Germany, France, and England have been, or will be, invited to participate in the discussions, according to President Baker's plans, and in addition papers will be presented by a number of leading American engineers and scientists representing the latest discoveries in connection with the distillation of coal, its by-products, new methods of producing energy from coal, etc.

Some of the topics that are now receiving the consideration of President Baker and his associates for discussion during the conference are the low-temperature carbonization of coal, generation of power at the mines, domestic use of coke, and water power vs. coal energy.

An advisory board of leading American men of affairs is now being organized to assist in the conference plans.

Dr. V. N. Krivobok, associate in the Bureau of Metallurgical Research of Carnegie Institute of Technology, has been awarded a grant of $500 by the Iron and Steel Institute of Great Britain to assist him in carrying out a photomicroscopic study of recrystallization of metals after cold-working, according to an announcement. Public announcement of the award, which comes from the Carnegie Research Fund of the Iron and Steel Institute, was made at the annual meeting of the Institute in London on May 6 and 7, 1926.

Dr. Krivobok has been a member of the staff of the Bureau of Metallurgical Research of Carnegie Tech since its organization by President Thomas S. Baker two years ago.

METALS

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Metal Mining Industry

THE CONDUCT AND VALUE OF MINE RESCUE STATIONS

Since A Mine Fire Is The Worst Catastrophe That Can Happen During The Life Of A Mine, In The Opinion Of Mr. Sparks Every Mine Should Either Install A Mine Rescue Station Suitable To Its Needs, Or Join With Other Companies In A Central Rescue Station

By K. T. SPARKS*

IN the mining industry there are very few mines which are entirely free from the hazard of an underground fire. Usually a mine fire is about the worst catastrophe that can happen during the life of a mine. This is especially true if the fire is accompanied by any loss of life, as such an occurrence gives the mine a "black eye" in the minds of underground workers. A mine fire is also a costly experience on account of the loss of production, and in the event of a large fire a great deal of repair work is necessary before the mine returns to a production basis.

Next to stringent fire prevention measures are the means of combating a fire, and under this head may be classed oxygen breathing apparatus and general mine rescue work.

Any mine which has passed the prospect stage should install a mine rescue station suitable to its needs. Many states have laws compelling the installation of a mine rescue station at mines where a specified number of men are employed. In villages and towns, no matter how small, there is always some sort of a fire department. Correspondingly, the same need exists at a mine which has become a producer, yet there are numerous mines in this country which have operated for years with no thought of mine rescue equipment.

The equipping, operation, and maintenance of a mine rescue station for an individual mine is usually a rather expensive project. This is especially true if the necessary breathing apparatus, supplies, and accessories are kept in good condition, up to date and in charge of a competent person. Individual mines, even after the installation of an adequate station, are prone to let the training work lapse and the apparatus deteriorate. This attitude usually results after the mine has operated for a period of years without an underground fire or disaster of any kind. In this way a false feeling of security is engendered, and sooner or later an emergency arises in which the need of perfectly working breathing apparatus, together with a number of trained men, is urgent.

A few years ago a fire occurred in a large western metal mine. Prior to this fire the same company had experienced another fire underground and at that time they did not have any rescue equipment at all. After the first fire they expended several thousand dollars in the purchase of oxygen breathing apparatus, supplies, etc. These were received in due time and placed in the mine warehouse. Upon the outbreak of the second fire it was found that the machines had deteriorated so badly that they were practically useless. They had not even been removed from the original boxes in which they had been shipped from the factory. No trained men were available, and before the work of actually fighting the fire could be undertaken it was necessary to give a number of men a short course of training in the use of oxygen breathing apparatus. Had this particular mine kept their apparatus in good condition, together with a number of trained "helmetmen," the enforced shut down with consequent loss of production would have been greatly reduced.

The expense and disadvantages of mine rescue stations for individual mines can be overcome by the establishment of a joint station to take care of all of the mines of a district. In this way the expense is borne proportionally by each of the mines served and does not become a burden on any one company. For the establishment of an efficient central mine rescue station, the geographical location of the various mines to be served must be carefully considered and also means of transportation between the central station and the various mines. The distance from the rescue station to the most distant mine of the group should not exceed 25 miles, unless road conditions are very favorable. This will allow speedy service from the central station to the mine in an emergency. The station should be located at some central point where the mileage to the member mines is about the same. Some means of transportation from the station to the mines is, of course, necessary. In the Coeur d'Alene

*Director, Central Mine Rescue Station, Coeur d'Alene Mine Operators' Association.

district of Idaho there is a smoothly working central mine rescue station which has been in operation for the past three years. This station has functioned efficiently at a comparatively low cost and will be briefly described.

Location of the Coeur d'Alene District

The Coeur d'Alene district lies in the approximate center of Shoshone County and comprises an area of about 400 square miles. Shoshone County occupies the larger portion of northern Idaho, known as the "Panhandle." The country is very mountainous and there is little land suitable for agricultural purposes. Mining and lumbering are the chief industries upon which the community depends. Shoshone County, which includes the Coeur d'Alenes, is the largest producer of lead-silver ore in the state, and for many years has produced 90 percent of the lead and 85 percent of the silver. The State of Idaho, ranking second in the United States in lead production and fifth in silver, shows the importance of the mining industry of the Coeur d'Alenes. The town of Wallace is the principal supply point of the district, and within a radius of 12 miles are located all of the important mines of the Coeur d'Alenes.

Above, Mine Rescue Training Work Underground at the Hecla Mine. Below, Mine Rescue Maneuvers at the Bunker Hill and Sullivan Mine

Necessity of a Mine Rescue Station

During the first two months of the year 1923 two underground fires occurred in the mines of the Coeur d'Alene district. Both of these fires, fortunately, did not result in any great loss of life, but were expensive on account of the enforced shut down.

Shortly after the second fire, which occurred in the month of February, the mine managers of the district held a meeting to discuss underground fires and their prevention. During the course of this conference the question of establishing a joint rescue station was brought up. This station was to be equipped with a suitable type of breathing apparatus, accessories, and supplies, and would serve all of the mines of the district. The mine officials were in favor toward the project and accordingly a future conference was arranged between the mine operators and representatives of the United States Bureau of Mines. This conference was held and resulted in the Bureau of Mines detailing an engineer to the district for the purpose of establishing the station and getting it to running smoothly.

Housing Facilities

After due consideration it was decided that the apparatus and supplies should be housed in a railroad coach instead of a building. This decision was made because nearly all of the mines to be served were on a railroad. By this arrangement the use of a large motor-driven rescue truck was avoided as the use of a truck would not be feasible in the winter time when the snow was deep. A former rescue car of the Bureau of Mines was purchased for this purpose. The car was changed to suit local conditions. The car is equipped with living quarters for a small crew and can be readily handled on regular passenger trains. The rescue car which forms the nucleus for the central mine rescue station of the Coeur d'Alene district is parked in Wallace. The car sits on a spur track which is common to both of the railroads of the district. A special engine is available at all times to quickly take the car to the scene of a mine fire.

Selection of Equipment

On account of the fact that the apparatus men or so-called "helmetmen" of the district were more familiar with the Paul oxygen breathing apparatus, this was selected as the standard for the district. Fourteen sets are carried on the mine rescue car. While each of these machines are complete in itself, there is considerable accessory equipment required. This consists of extra oxygen bottles for the machines, large storage tanks of compressed oxygen, regenerating cans, etc. High-pressure oxygen pumps, both motor driven and hand operated, are provided for refilling the smaller oxygen tanks on the machines from the storage cylinders.

The breathing apparatus mentioned above is of the so-called two-hour type, i. e., under ordinary working conditions the machinery will supply oxygen to the wearer for a period of from two to two and one-half hours. The time limit the machines can be worn is elastic, as they are provided with a variable feed valve, whereby just the amount of oxygen required is fed to the wearer. This means that the working period of the machines depends upon the work being done.*

In addition to the large machines there are several smaller ones which will supply oxygen for a period of from three-quarters to one hour. These smaller machines were procured for use as a rescue apparatus and not for actual fire-fighting purposes except in a confined space close to fresh air.

Small gas-filtering devices known as "self-rescuers" are also on hand. These are used for short trips through a gassy or smoke-laden atmosphere where there is plenty of oxygen available.

Two thousand regenerating cans, together with an ample supply of spare parts for the apparatus, repair materials, etc., are carried in stock on the rescue car. A complete outfit of small tools for repairing the apparatus is also on hand. Various devices for testing the apparatus, such as flow meters, pressure gauges, and volume bags are available.

In addition to the above, a complete line of gas-testing apparatus is carried. This includes detectors for carbon

*Self-Contained Mine Rescue Oxygen Breathing Apparatus, Bureau of Mines, Washington, D. C.

monoxide, carbon dioxide, and methane. Orsat apparatus is available for a complete analysis of mine air. Several flame safety lamps of the approved, permissible type have been provided.

Resuscitating devices consist of inhalators for administering both pure oxygen and a mixture of oxygen and carbon dioxide. The latter apparatus was devised by Doctors Henderson and Haggard of the Yale Physiological School.†

For underground fire work battery type searchlights have been provided, each man on a team being supplied with a lamp. They have a high-power bulb and will throw a beam of light a distance of 500 feet.

Large portable searchlights are also available. These lights are designed for use on mine power lines. They are equipped with 1,000 watt bulbs, and have a long armored cable attached so that they may be used where needed.

Life lines, consisting of light rope wound on a reel, are useful at the time of a mine fire, and several are on hand. An apparatus crew takes the end of the rope with them from the fresh air base, and by this arrangement are able to find their way out and the succeeding crew their way in. Life lines are a necessary part of mine-rescue equipment when the mine is filled with a dense smoke and apparatus men are employed from other properties.

An ample supply of special fire hose fittings are also carried on the car. These consist of plugs to connect the female ends of two hose lines together, receptacles for connecting the male ends of two fire lines together, revolving nozzles, spray nozzles, reducers, quick connectors, etc.

Rescue Stations Located at Mines

Each of the large mines of the district have a rescue station located at the mine. The mine stations are under the general supervision of the Central Mine Rescue Station. All of the mine stations are completely equipped with from 5 to 15 sets of apparatus, and an ample supply of spare parts, oxygen pumps, and regenerating cans. In the event of a large mine fire in the district, all of the equipment at each of the mine stations, together with the equipment from the rescue car, could be concentrated at one place in a very short time. This would give about 90 sets of apparatus and a large quantity of spare parts.

Training of Rescue Men

The men who are to become "helmetmen" are carefully selected. They must be young men who are physically fit. Intelligence, coolness, nerve tempered with caution, and ability to think quickly in an emergency are additional requisites. The necessity of these qualifications will be seen when it is known that crews in this district are often called upon to travel nearly a mile through underground drifts filled with poisonous gasses or irrespirable air, and often work in temperatures as high as 160 degrees Fahrenheit. Permanency at the mine where they are employed is another factor considered, although this is not so important, as men leaving one mine of the district usually find employment at another, and hence are still available.

The men are trained in groups of five, as this is the best and most conveniently handled number to get the maximum efficiency. The training covers a period of three months at three-week intervals and last four hours each time. Preliminary steps in training consists of learning the basic principles, the construction, circulation, and tests of the breathing apparatus. After this the men wear the apparatus, first in fresh air and later in an irrespirable atmosphere. This usually consists of wood smoke, sulphur, or formaldehyde fumes. In both fresh air and gas the men are required to perform hard physical labor, and do certain exercises designed to bring the large body muscles into play, which causes the maximum oxygen consumption. Confidence in the apparatus is thus established, and the men learn the limitations of the machines and just how much work they can do while wearing them.

After the first course of training is completed, they receive practice with the apparatus one afternoon every month for an indefinite period. During these practice periods they are released from their regular work in the mine and report at the rescue station. Compensation is, of course, allowed during this practice. About 200 men are in active training at all times, being divided proportionally among the large mines. Several of the mines pay their "helmetmen" a bonus of $0.25 per shift over the regular scale of wages. In this way there is always a demand for a place on the rescue teams.

In conjunction with the mine-rescue training, a certain amount of first-aid work is also introduced, especial attention being paid to methods of artificial respiration. A close cooperation in both the first-aid and mine-rescue work is maintained with the United States Bureau of Mines.

Cost of Rescue Equipment in the Coeur d'Alene District

All of the large mines of the district are banded together in an informal organization known as the Coeur d'Alene Mine Operators' Association. The mines contribute to a general fund at the rate of $0.05 per ton of ore mined. By this arrangement the cost is distributed according to the output of each mine. The fund is administered by an agent appointed by the mine managers.

The rescue equipment of the Coeur d'Alene district forms one of the most complete installations in the United States. The Mine Operators' Association have spared no expense to make it complete. The equipment represents an investment of about $35,000. This figure includes the rescue car and its contents and the rescue stations located at the mines.

Use of Oxygen Breathing Apparatus‡

The mining industry at present has innumerable safety devices available to protect the life and health of the workman. Many of these are designed to supplement the intelligence of the miner, with the result that he places too much reliance in the device and not enough in his own carefulness. This is true of oxygen breathing apparatus, often called "safety helmets." As a matter of fact, oxygen breathing apparatus is far from safe. To the general public and, unfortunately, to many persons actually engaged in mining, the use of oxygen breathing apparatus is more or less shrouded in mystery. They assume that in the event of a mine fire or disaster all that is necessary to do is to send men equipped with the "helmets" into the mine, and in some miraculous manner the rescue and recovery work will take care of itself. The idea is erroneous. Men in order to make good "helmetmen" and to accomplish anything at all must undergo a strenuous course of training.

Self-contained oxygen breathing apparatus was introduced into this country in about the year 1907. Shortly after this time the United States Bureau of Mines, then the Technologic Branch of the United States Geological Survey, began the training of miners in the use of the apparatus.

During the last 10 years the increase in the number of mining companies owning apparatus has been decidedly noticeable. Several states now require mines of a certain type and development to be equipped with oxygen breathing apparatus and train their employes in their use. Some of the states maintain well-equipped rescue stations. Several insurance companies grant reduced rates to companies operating mines having rescue apparatus and regularly trained men.

Oxygen breathing apparatus properly maintained, together with a crew of trained men, is a very real asset to any mining company. The history of mining is replete with instances where a mine having had an underground fire has been saved for (*Continued on page* 456)

†Report I of the Commission on Resuscitation from Carbon Monoxide Asphxia to the American Gas Association, by Henderson and Haggard, American Gas Association Monthly, September, 1922.

‡Abstract from the Report of Investigations, Serial No. 2445, U. S. Bureau of Mines.

ESSENTIALS FOR DOING EFFICIENT SAFETY WORK

Safety Engineering As Much A Part Of Mine Operation As Are Operating And Cost Reduction Problems—Management Should Give Sympathetic Cooperation In Creating Interest In And Observation Of Safety-first Principles—Certain Basic Essentials Of Safety Work Outlined

By THOS. COWPERTHWAITE*

EFFICIENCY in safety work does not mean merely reducing accidents to a minimum. Accident prevention work may be done in such a manner as to increase costs. It is necessary for the safety engineer to study the problem and devise methods by which accidents may be reduced to a minimum, and at the same time be instrumental in increasing production while reducing costs.

In some industries it is no easy matter to show that a minimum accident record has been a major cause of increased production. In fact, the safety department is given little or no credit if production increases. Accident statistics are frequently based upon the number of shifts worked rather than upon production. If the accident record remains stationary, and the number of shifts worked does not increase, and production increases, should not the safety department receive credit as well as other operating departments? This point is often overlooked, as safety work has not yet been applied as a real form of efficient business operation. Safety problems are often tabled, to be discussed at odd times, and are frequently tabled and forgotten. A problem of operating or production costs is never overlooked and is thoroughly thrashed out. If these same principles were applied to safety problems, a minimum accident rate would soon result.

I am not criticizing the methods used in solving operating problems. Ninety-five percent of our industrial managers and superintendents are willing to do anything in their power to prevent accidents, but have failed to consider it a major part of business transaction. Safety engineering is only in its infancy. Very few men have been trained to handle safety work and a large percentage of our present higher officials are not trained safety workers, and to be successful they must depend upon their subordinates to solve such problems.

I recently read in "The Houghton Line" that "the ideal organization is one in which every man knows more about his work than the boss." A very true definition for an ideal organization, but under it one should also find that "an ideal boss is one who will invite and consider suggestions from his workmen." To make it complete: "An ideal workman is one who is willing to cooperate in doing a fair day's work, using the safest methods possible while so doing."

To teach men to be ideal workmen is the hardest problem the safety engineer has, and is not only one of the essential requirements but is *the* essential requirement to establish an efficient safety organization.

As I have stated at the beginning of this article, safety efficiency depends not only upon a reduction of accidents but also upon the cost of reducing accidents. It is unnecessary to overburden a corporation with overhead expense, as one safety inspector with the proper cooperation can cover a large territory. Therefore, in order to reduce accidents to a minimum without increasing the cost of operation, it is necessary that keen interest be shown by the management and from there down, step by step, to the boss who has direct charge of the workmen.

To arouse proper interest in safety work it is necessary that the problem be conscientiously considered as a business problem and treated in the same manner as operating or production problems.

The superintendent is the second executive in line who must be interested in accident prevention if efficiency is desired. There is little question that safety work will be properly conducted by the superintendent if the general manager desires it, but his interest is of first importance. The superintendent makes many trips through the plant, and if he is interested in accident prevention he can readily detect unsafe conditions and can often observe whether or not his under executives are closely watching the actions of their workmen. In case he finds one of his under executives allowing workmen to be careless, he should at once ask him for an explanation. This point is the failure of many safety organizations. When you find a manager, a superintendent, or a boss who will watch workmen do unsafe acts and allow them to continue without punishment of some sort, you will find an organization which is not efficient, no matter how well guarded the place may be. The superintendent who has the required authority to demand that working places be kept in proper condition, if he is sufficiently interested in safety work, will have no trouble with his under executives.

Next in line are the bosses working under the superintendent. These bosses are directly responsible for good working conditions and are the principal factors in safety efficiency. It is not only necessary that a good boss be a good workman, but his personality must be pleasing; he must be capable of observing small defects, for more accidents are caused because of small defects than any other way. A bad condition is usually noticed by all bosses and workmen, and, because danger is conspicuous, care is exercised by those in charge and by the workmen, with the result that we do not encounter many bad accidents.

Let us consider the qualities essential in a good boss and the action necessary in order to secure efficient safety work. He should be thoroughly acquainted with his work or workmen will soon lose confidence in his ability. He should have a likeable personality, otherwise his workmen may become dissatisfied. A heavy labor turnover is always a detriment to safety efficiency and all other classes of efficiency. He should be capable of observing small defects, or, no matter how capable he is otherwise, his accident record will not be reduced to a minimum. He should not be afraid nor too backward to criticize workmen who are found working under unnecessarily dangerous conditions. He should even go so far as to lay off or discharge the workman who he finds will continue this practice. Last, but not least, if he requires that his workmen thoroughly examine and make safe their place of work before they start real operation, his work of preventing accidents is 80 percent completed, and his production efficiency will be 10 percent increased.

Now, let us consider the workmen. They are the folks we are trying to protect. Some will care for themselves with but little instruction. Others will care for themselves along lines in which they are instructed. Still others, after being instructed, are careless, thoughtless, and negligent. The latter two classes are not only burdens to themselves but to their fellow workmen. They must be dealt with individually, otherwise they will continue to be careless and negligent. This class causes 80 percent of our industrial accidents, and unless we deal more severely with them there is little chance of a lower accident rate.

The problems which confront the safety engineer are to solve these various things. The safety engineer does not possess unlimited authority, and therefore problems worked out by him must

* Safety Inspector, Calumet & Arizona Mining Company.

be approved by all executives, at least from the foreman to general manager. Any one of these executives may prevent successful application of his proposed solution, in spite of the fact that it has taken a great deal of his time to collect sufficient data to satisfy him that it is of benefit to safety work and therefore to his company. The safety engineer is not going to establish anything that will lead to trouble. If his ideas are sound and will not interfere with other results, let him have a chance to demonstrate them. Many years ago I discovered that some men must be punished before they would practice self-protection. It was necessary for the boss to tell his men each day to bar down their ground before working under it. Oftentimes his men would get hurt before he arrived at their place of work. I inquired of men why they worked under ground that might fall and injure them. In the majority of cases I found it was because they did not want to handle the extra rock. It was evident that this work must be done sooner or later and nothing was being saved by letting it go from one day to another. After being satisfied I was on the right track, I asked to have a "lay-off system" adopted. After several months of discussion at our monthly meetings (the system being discussed by me only, as no other desired to discuss it), our superintendent stated that it would be adopted, as there had been no argument against it. A foreman at one of the mines saw its advantage, and the first month he cut his serious accidents 50 percent. It was only necessary to lay off a few men for three or four days each when it was first started, the others soon falling into the line of self-protection.

Another system I advocate is getting men with slight injuries back to work as quickly as possible. Some men with slight injuries will not lose a shift, while others with the same injury will lay off from two to three weeks. The men who do want to work should be given something to do. In mining there are always places which should be cleaned up, and the corporation is only paying the injured man the difference between his regular wages and the compensation which they must pay whether he works or not. Again he is doing work which is creating efficiency. The injured man is also more satisfied, as he is not unduly worried by finances, and the satisfied workman is always more efficient than the dissatisfied one.

The safe way to accomplish a thing is not always the easiest way, or we would have less trouble training men in the safety habit. Quite often men will take a chance rather than do a little extra work. These are cases where the lay-off system will prove beneficial.

Safety engineering is in a class of its own. It is necessary for the safety engineer to solve practical safety problems, and to do this properly he must understand human nature. Many men consider only their own safety and not the condition they leave for the safety of others. This is one reason why it is necessary that all higher executives consider safety work a real part of their business and do their utmost to create interest and cooperation between workmen and executives. Do not hold your safety engineer's ideas at bay—give him a chance to put them in operation. Do not hold him to some routine way of doing his work, but turn him loose with sufficient authority to make good.

If executives are not sincere in accident prevention, it will help others if they do not profess to be. When a workman has worked in an industry where safety first is only used as a byword, it is hard for other industries who later may employ him to teach him that safety is not merely a word but a real business.

SAFETY AND WELFARE AT HOMESTAKE

(*Continued from page* 410)

large, fully equipped stage, a pipe organ, a full-time orchestra for the picture show. The building seats 1,000 people. A nominal fee is charged for attractions in the theater, but everything else in the building is free to the people of the city.

The library is well supplied with fiction and non-fiction, all the latest magazines and newspapers, a few of the latter being in foreign languages, bound volumes of the better magazines and trade papers, and a good collection of rocks and minerals of the Homestake and Black Hills.

During the winter months there is a bowling tournament between teams from the different departments.

All the departments of the company go to work one hour early during the summer so that they can play baseball. They play three five-inning games every week. These games are between teams from the different departments. The Homestake furnishes the balls, mits, and bats and pays two umpires and a scorekeeper.

CONDUCT AND VALUE OF MINE RESCUE STATIONS

(*Continued from page* 454)

future operations solely through the accomplishments of the apparatus men. Apparatus crews have on numerous occasions made hazardous trips through gas-filled passages of a mine to recover bodies and rescue living men. They have changed the ventilation at the request of responsible authority, bulkheaded underground fire so that they are localized, and in many instances fought the fire by direct means. The value of mining property saved through the use of oxygen breathing apparatus is, of course, enormous.

INCREASING THE RECOVERY OF OIL

A COMPREHENSIVE investigation of the problem of increasing the recovery of oil from oil sands has been undertaken by the Bureau of Mines at the petroleum experiment station, Bartlesville, Okla. This problem is one of the most important that now confronts the oil industry, as it is generally estimated that only about 20 percent of the oil underground is recovered by present methods of flowing and pumping. An investigation of the methods in use for increasing the recovery of oil was made several years ago by J. O. Lewis, formerly chief petroleum technologist of the Bureau of Mines, and the results were published in the Bureau's Bulletin 148.

D. B. Dow, who has been in charge of the Laramie, Wyo., office of the Bureau of Mines, has been transferred to the Bartlesville Station to take charge of this important work. Mr. Dow is exceptionally well qualified to direct this work, for, in addition to his other duties, he has made a study of the solubility of natural gas in crude oil and the effect of dissolved gas on viscosity. A report of this work has recently been issued as Serial 2732 of the Bureau of Mines. Mr. Dow is the author of several reports of the bureau on natural-gas gasoline and recently completed an extended investigation of methods of treating oil-field emulsions.

The bureau plans to study a number of the physical properties of crude oil that affect the recovery of oil from sands, such as surface tension, viscosity, capilarity, etc. An effort will also be made to keep in touch with recovery methods that are now in practical use.

Under the present wage scale, the Coeur d'Alene district is paying the highest mining wage in the United States. Other camps use considerable contract work, a large portion of the Butte miners being on contract basis, which results in a high average per day. The contract system has never been much in use in the Couer d'Alenes, the Federal company at Mullan being practically the only large mine to make use of this system to any extent.

Italy produced 490,000 metric tons of pig iron and 1,685,000 tons of steel during 1925, according to estimates of the Italian Bureau of Mines. These totals are the largest recorded in the history of the industry in that country.

THE MEXICAN LABORER AND HIS SAFETY

The United Verde Copper Company In March, 1925, Inaugurated A Special Plan To Assist Its Foreign Employees To Eliminate Accidents—A Description Of The Plan And The Results Obtained Are Given In The Following Article

By A. S. BILDERBACK *

THE United Verde Copper Company employs a number of skilled and unskilled Mexican laborers. These men are engaged in various kinds of underground work, and are subject to the usual hazards found in metal mines. Their safety record had shown little or no improvement the past few years. It was noted in 1923 that Mexican employes constituted 65 percent of the underground force, and furnished 83 percent of the injured men. A new safety campaign was started March 1, 1925, to remedy this situation.

It was decided to confine all safety activities at first to three departments, i.e., the employment division, the bossing organization, and a safety society which was formed later. To assist in interesting men in SAFETY, a Mexican assistant was placed in the Safety Department. The safety work in each department is taken up separately so that an analysis can be made.

EMPLOYMENT DIVISION

The employment office, where first impressions are made, appeared the logical place to start teaching the value of careful work. Safety training begins here at this mine. The men are divided into English and Spanish speaking groups after they have been hired. The English speaking men are instructed by the safety engineer, while the Spanish speaking men are handled by the Mexican safety assistant. The talks made by the Mexican assistant follow a carefully prepared outline. While they vary somewhat each day, the following points are always emphasized:

1. The three main dangers that underground men must constantly guard against : (a) Falling ground, (b) explosives, and (c) haulage equipment.

2. The Company's attitude on work—"No work is good unless it is first SAFE."

3. The necessity for clearly understanding instructions covering—*What To Do and How To Do It.* Men are cautioned to ask for a second explanation in case they do not understand their instructions. It has been noted that dual languages lead to misunderstandings, misunderstandings lead to mistakes, and mistakes lead to many accidents.

4. The company policy of laying off and discharging men who do not obey safety rules.

The four points mentioned were selected for discussion, after a number of subjects had been tried and discarded. It was noted that men generally became interested in any discussion dealing with mangled or dead men. As a rule the three classes of accidents mentioned produce such victims. While care must be used not to scare new men, a clean cut understanding of underground dangers is essential. The subject of good work follows, once the interest of the men has been secured. The idea that all work can be done safely is taken up at this time. When handled properly, each man should leave the employment office with the idea firmly established in his mind that he can make his living without being injured. To assist him in his work is his shift boss. This man is always ready to instruct him, provided the new man makes known his troubles. Dual languages in this mine are a danger that always must be guarded against. The penalty system is the last subject discussed and is for the benefit of those men who only appreciate force. Good men do not need a penalty system, and they should not be allowed to work in constant fear of losing their job due to some trivial mistake. On the other hand, the class of men who only appreciate force are much easier to train when they know that such a system exists. Having finished with the details of employment, the new men are ready for work.

BOSSING ORGANIZATION

At the present time each shift boss in the United Verde Mine trains his own men. When a new man reports for work, he is taken in hand by the shift boss himself or is turned over to a jigger boss for training. The new man is taken to his working place by his boss, where the work is explained and the dangers surrounding it noted. The new man is then assigned to an "old timer" who shows him the way in and out of his working place, the location of the drinking fountain, the toilet, and the gas chamber. Such details require little time and prevent men from being unjustly accused of loafing when found wandering about on the levels seeking such places. The "old timer" keeps an eye on his partner, explaining at times the details which the new man fails to understand. The safety training continues until the shift boss is satisfied that the new man is able to take care of himself. The period required varies, depending on the aptitude of the man and the teaching ability of the boss.

This method of handling new men has proven fairly successful. New men in 1924 constituted 42.6 percent of the injured employes, while in 1925 they constituted only 8.1 percent of such cases. The knowledge that everyone from the employment agent to their fellow workman is interested in their welfare makes a lasting impression upon the new man of the importance of SAFETY. The "old timer" not only takes a pride in such work, but is able to clear up many points for the Mexican laborer in his own language which he understands. The bossing organization is in favor of any plan which will reduce their accidents and, in turn, criticisms of their safety work. The management has always maintained that something is wrong with the organization when men are injured before they have been trained to take care of themselves. It must be admitted that men are not injured by choice.

Failures have occurred, probably caused in part by the inability of the safety department to reach each individual. On the other hand, lack of time on the part of the shift boss to devote to each man the proper time for instruction may be another factor involved. This method will be continued until a system giving better results is worked out.

UNDERGROUND SAFETY MEETINGS

Underground safety meetings are held in the mine at regular intervals on the various levels. These meetings are attended by both English and Mexican employes and their bosses. The meetings are held after lunch time and last about 20 minutes. Safety talks are made by the safety engineer and are translated line for line into Spanish by the Mexican assistant. General safety problems, together with local troubles, constitute the major part of the discussions, but additional time is taken to advance new safety ideas and to answer questions. It has been found by experience that best results are obtained by:

1. Holding joint meetings of bosses and men. Separate meetings for English and Mexican men were first held. This separation soon led to many misunder-

* Safety Engineer, United Verde Copper Co.

standings between bosses and men. By holding joint meetings, an opportunity is afforded to clear up any misunderstandings at once.

2. Frankness in answering questions. All questions as a rule relate to past accidents or the parties responsible. In discussing such matters, the party or parties at fault are always named, whether it be company, man, or boss. This policy has assisted in securing the confidence of the men so that at the present time, when men are criticised for carelessness, the justice of the criticism is seldom questioned. Many of the bosses have assisted in developing the spirit of fair play. They have asked for complaints at the close of their meetings, and upon receiving suggestions have at once sent skilled men to remedy the situation. Such action not only prevents criticism of their work, but teaches their men to come to them for assistance in keeping their working places safe. Where mutual understandings of this kind exist between men and bosses excellent safety records are usually found.

3. Illustrating the value of cooperation among workmen. In all underground work each man must necessarily learn to take care of himself. By studying the details of the work it is sometimes possible for one group to assist another group in such work. On the other hand, the class of men benefitted can in turn, by simple rearrangement of their work, return the favor. It has been found that men as a whole understand such cooperation and are keenly interested in such matters.

The Mexican Safety Society

The society was formed June 19, 1925, for the purpose of interesting men in the value of safety in their work. The leaders of the Mexican colony were gathered together before any steps were taken, the need for safety work among the Mexican people explained and their support in this undertaking solicited. These men deserve credit for their efforts and a large part of the success of the society has been due to their personal interest.

The society is controlled by seven men selected by the Mexican employes. These men approve all programs before they are presented by the safety department. All expenses are borne by the company; buttons are also issued by the company as follows:

Copper buttons are issued for three months' work without injury;

Silver buttons are issued for six months' work without injury;

Gold buttons are issued for one year's work without injury.

Buttons are issued for good work and not for attendance at safety meetings. It is felt that when the meetings of this society are made interesting enough no trouble will be experienced in getting the men to attend. The company has placed a definite value upon the gold buttons; a "gold button man," who has left the service and wishes to return takes first place at the employment office, irrespective of the men who have been waiting on the list.

There is no inspection committee. The attitude of the men was expressed by one miner when he said, "If a man and his boss cannot keep his working place in good shape, the fault lies with them and not with the society." No time is lost at the meetings in listening to the reports of such committees.

The meetings of the society are held at night in the town hall. Speeches, first aid work, safety demonstrations, and music constitute the program. No trouble has been experienced in getting the miners and timbermen to talk at these meetings, and some of the speeches have been a credit to the men making them. The phase of this work that needs more development is the safety demonstration part. Some success has been had in this work, particularly with regard to the eyes. The men, having been divided into groups, were blindfolded; they then in turn tried to do the everyday things of life, such as finding their hats and shoes from a number of others. The interest developed at this meeting was shown the following morning when 48 men came into the safety department and changed their goggles. Such work among the Mexican employes apparently needs attention.

Safety work, like all other industrial activities, is measured by results. The following figures cover a six months' period only and will be examined with much interest after sufficient time has elapsed to permit the education work to assert itself.

	7-1-24 to 12-21-24	7-1-25 to 12-31-25	Remarks
No. of Mexican laborers employed (daily average)	649	587	Decrease 10%
No. of Mexican laborers injured (lost time 14 days or more)	89	37	Decrease 58%
No. of Mexican laborers injured who had worked less than two months (lost time 14 days or more)	38	3	Decrease 92%
No. of men hired without previous experience in mines (all nationalities)	624	284	Decrease 53%
Total No. of men hired (all nationalities)	1,494	866	Decrease 42%

From the figures given it is evident that some progress has been made in teaching the Mexican laborer the value of careful work. If such data is used for any purpose except as a signboard to indicate the direction of the safety movement, it is useless. It is noted that along with the reduced accident rate a sharp reduction in labor turnover has occurred. This is an important item, for as the number of new men to be trained decreases, the time and attention which can be given to the new employe increases.

Safety work should develop many interesting phases in the future. In the opinion of the writer mine safety work should profit by:

1. The development of standardized safety methods. When possible a uniform code of safety instruction should be used in all mines. Underground men are constantly changing from one mine to another and such a code would assist in removing the confusion of ideas now found in the minds of ignorant men.

2. The placing of a proper value on careful work. The man who can work without injuring himself, other factors being equal, is of greater value in industry than the man who is constantly getting into trouble. If this is true, then a system should be worked out which would not only pay the workman his just reward, but would also make possible his recognition. For the mining industry, the writer suggests a universal safety society which issues safety buttons and cards for the performance of careful work. In addition, the man could be advised that preference would be given by all mines to all men carrying such credentials when applying for work. It is the opinion of the writer that such a system would place a value on careful work which the most ignorant man could understand.

3. The development of interesting ways to teach SAFETY. An examination of the safety work in most mines shows that periods in which there are few accidents are followed by periods in which there are many accidents. In addition, there is generally found an enthusiastic safety engineer, a semi-enthusiastic bossing organization, and an interesting employe who refuses to commit himself. The deep-rooted and fatalistic idea that we are sure to kill or injure a certain number of men is one of the greatest obstacles to a safety campaign. This idea must, if we are to be successful, be replaced by a firm determination that *all accidents are avoidable*, if the proper degree of intelligence is applied in our safety work and instructions. SAFETY must be sold to the men themselves and the progress which is made will be determined by our ability to develop selling ideas.

COAL

PRACTICAL OPERATING MEN'S DEPARTMENT

Practical Operating Problems of the Coal Mining Industry

ROCK DUSTING AND RECENT COAL MINE DISASTERS

While Rock Dusting Is One Of The Most Effective Of Present-Day Protections Against Explosions, It Is In Reality Only A Secondary Defense—So Long As Mines Neglect The Primary Defense Of Up-to-Date Methods And Practice We Will Continue To Have Disasters

By D. HARRINGTON *

BELOW is a tabulation of available information concerning some of the salient features of 13 coal mine disasters which have occurred in the United States since December 1, 1925, data having been obtained from several sources, in some instances from engineers who entered the mine after the explosion.

These 13 disasters with loss of 261 lives during a three-month period of the past winter involved nine states: Alabama, Colorado, Ohio and West Virginia having two disasters each, while Illinois, Kentucky, Oklahoma, Pennsylvania and Washington escaped with one each. Open lights and gas were responsible for starting three explosions with total deaths 147; flame safety lamp and gas caused one with 5 deaths; electric arc and gas or dust caused 5 disasters with 66 deaths; and shots started 4 disasters with 43 deaths. Of the five disasters listed as initiated by electric arcs, one was a mine fire and one was a fire which later caused an explosion.

Two of the mines (Orient No. 2 and Horning) were rock dusted fairly close to the place where the explosion started and in both instances the explosion is said to have been stopped when it encountered the rock dusted region pos- No. 2 and approximately 300 in the sibly saving about 1,000 lives in Orient Horning, there being 5 killed in the Orient No. 2 and 19 in the Horning. Three of the 13 mines were said to have some system of watering and in each case men came out alive and it would appear that saving of their lives should be credited to sprinkling if rock dusting is given credit in the Orient and Horning; these sprinkled mines were Jamison No. 4, in West Virginia, where 19 were killed and 28 escaped; Eccles, W. Va., where 18 were killed and 44 escaped, and Overton, Ala., where 52 were killed and 56 escaped. In addition the Mossboro explosion in Alabama in which 27 were killed and 15 escaped, is said to have been stopped by wet zones though it is not stated that sprinkling was being done in the mine. Of the other seven mines involved, it is understood that neither sprinkling nor rock

Location	Mine	Date	Number killed	Cause of explosion	Rock dusted	Sprinkled	Explosion stopped by
Birmingham, Ala.	Overton	12-10-25	52	Open light and gas	No	Yes	Wet region
Wilkeson, Wash.		12-14-25	5	Blown out shot	No	No	Wet region
Bellaire, Ohio		12-23-26	9	*Elec. arc and coal	..	..	.....
Wilburton, Okla.	Degnan-McConnell	1-13-26	91	Open light and gas	No	No	.....
Farmville, W. Va.	Jamison No. 8	1-14-26	19	Elect. arc and gas	No	Yes	Wet region
Rifle, Colo.		1-22-26	3	Blown out shot	No	No	.....
Trinidad, Colo.	Bear Canon	1-29-26	4	Open light and gas	No	No	.....
Frankfort, Ill.	Orient No. 2	1-29-26	5	Flame safety lamp and gas	Yes	No	Wet rock dust region
Helena, Ala.	Mossboro	1-29-26	27	†Blown out shot	No	No	Wet region
Pittsburgh, Pa.	Horning	2- 3-26	19	Elec. arc. & gas plus dust	Yes	No	Rock dusted region
Powhattan, Ohio	Powhattan	2-15-26	1	Elect. arc and gas	No	No	.....
Central City, Ky.	Nelson	2-16-26	8	Blown out shot	No	No	.....
Eccles, W. Va.	No. 5 Mine	3- 8-26	18	Elect. arc and gas	No	Yes	Wet region
Total	13	.....	261	.....	..	..	.....

* Mine Fire. † Mine fire followed by an explosion.

* Consulting Mining Engineer.

dusting was done systematically if at all, yet men came out alive from at least two of the seven, about 10 coming out of the Degnan McConnell mine in Oklahoma, while 19 or more came out of the Powhattan mine in Ohio. In addition approximately 70 came out of the Bellaire, Ohio mine where there was a fire but no explosion.

What prevents an explosion from covering an entire mine is problematical in many instances and it is easy to jump at conclusions. Detailed reports of the Horning affair indicate pretty definitely that rock dusting prevented extension of that explosion and probably saved the lives of many if not all of the approximately 300 men in the mine who came out unharmed. While rock dusting has been very widely credited with stopping the explosion in the Orient No. 2 mine in Illinois on January 29, 1926, an authoritative written report of the explosion states that— "*rock dust prevented its propagation even though the rock dust was not blown into a cloud because of its wetness.*" From this it would appear that moisture rather than rock dust should be given the credit for stopping the Orient No. 2 explosion; however it is a question whether either rock dust or moisture is entitled to much credit for limiting the Orient No. 2 explosion in view of the fact that a gas explosion in the nearby Orient No. 1 mine on November 26, 1923, with over 800 men in the mine resulted in death of 2 men and burning of 14 others and stopped without intervention of either sprinkling or rock dusting, an engineer's report stating—"*it is hard to understand why the explosion once started did not sweep through the entire mine. There is certainly ample fine dry coal dust along the roads and ribs to propagate an extremely violent explosion.*" In any event the owners of the Orient No. 2 mine should be given full credit for having done the rock dusting in that mine and other companies may well profit by their good example.

While rock dusting is unquestionably one of the most effective of present day protections against wide-spread disaster in a coal mine, it must be borne in mind that rock dusting is really a secondary defense; and so long as our mines neglect the primary defense of safe up-to-date methods and practices and continue to use the dangerous methods brought to light by the recent explosions we will continue to have at least local explosions with loss of many lives notwithstanding all the rock dusting we may do. Some of the poor practices brought out by recent explosions are: use of mining machines without water; use of small auxiliary blower fans and tubing instead of bratticing; use of key locked flame safety lamp and carrying of matches into closed light mine by safety official; use of black powder instead of permissible explosive; shooting "off the solid" with holes 7 or 8 feet straight in; shooting by miners with the shift in the mine; use of open lights; use of open type of nip on mining machine cables; use of open type mining machines; use of bare power lines; sealing a mine fire with shift in the mine; "bulldozing" with dynamite; use of water car on haulage road and calling it sprinkling the mine; use of hose sprinkling on haulage roads but leaving faces, non-working rooms or other workings dry. Undoubtedly ventilation practices must have been poor since at least 8 of the 13 explosions were started by gas ignitions; and probably there were other equally poor mining practices in vogue in at least some of these mines.

Whether rock dusting or watering or both are acknowledged as having limited the explosions in the Orient, Horning, Jamison, Eccles, Overton and Mossboro mines, there is absolutely no question that all of these mines (as well as all of the seven others which had disasters) should have used both rock dust and water, the water at the face regions on the cutter bits and for keeping the entire face region well washed down and well wet down; and rock dust should have been applied freely on the haulage ways and in all open parts of the mine which are not wet except that as heretofore stated the faces should be treated with water. Haulage ways which are rock dusted but have spillage coal on floors should have the floors kept *wet* by hose, water car or other means as it has been demonstrated that fine dry spillage coal dust on haulage floors will readily feed and forward an explosion even if the ribs, roof and floor have been rock dusted.

If water and rock dust had been used efficiently in all these mines, there is no question that the death list would have been held to the comparatively few persons in the immediate vicinity of the origin of each explosion and if safe sane mining practices had been in general vogue there need have been no original explosion. Rock dusting should not be a mere gesture such as recently seen in a fairly large capacity mine in the west where the management bought and spread seven tons of rock dust and appeared to consider that it had performed its full duty to the mine and the hundred odd underground workers! Any reasonably extensive mine will not be effectively rock dusted until several hundred tons of rock dust have been efficiently distributed; and any mine management which relies upon rock dusting as a preventive of explosions and fails to take frequent samples and make analyses as to explosibility of the dust in mine workings, with the renewals of rock dusting where necessary, will certainly fail lamentably in performance of its duty. Those who take rock dusting as a cure all for the dangers found in coal mines, neglecting ventilation, using open lights, having poorly placed electric power lines, using open types of electrical equipment, or black powder, or key locked flame safety lamps or any of the other only too numerous dangerously bad practices in our coal mines, are at least equally as blameable as those who fail to rock dust but who do use fairly decent mining methods. While all mines should rock dust, the rock dusting should be efficient and certainly should not be accompanied by relaxation as to other precautionary measures.

The necessity for rock dusting is well shown by Safety Circular No. 48, issued April, 1926, by the Associated (Insurance) Companies, of Hartford, Conn., stating that on and after October 1, 1926, the Associated Companies will not insure for compensation, any gaseous or dusty mine until it has been rock dusted and will cancel policies now in force as to gaseous or dusty mines unless they have been rock dusted by October 1, 1926. Furthermore, rock dusting a bituminous mine is defined as: "The coating by appropriate machinery of *all surfaces* in the mine with a layer of very finely pulverized rock dust and to a sufficient depth so that there will be at least twice as much rock dust as there is coal dust." The above drastic requirement of probably the largest compensation insurers of coal mines in the United States is undoubtedly at least an indirect result of the "*epidemic*" of disasters of the past winter, and if this is a fact the sacrifice of the 200 odd lives will not have been in vain.

PRODUCTION OF STEEL BY DIRECT METHODS

CONSIDERABLE work has been done in the past on the production of steel by direct processes and numerous patents relating to this problem have been granted. The Bureau of Mines has made a thorough investigation of the production of sponge iron and the utilization of this material in the form of pig iron and steel. It is the purpose of an investigation being conducted at the North Central Experiment Station of the Bureau at Minneapolis to make a survey of all the work that has been done on direct processes and to determine what fundamental information is needed to develop direct methods for making steel. Gaps in the present fund of information will be filled in by laboratory experiments.

The Bureau of Mines is particularly interested in the use of non-coking fuel in reduction and the utilization of low-grade ores by concentration after metallization has taken place.

SOME OF THE CAUSES OF MINE FIRES

Possibly Nothing More Serious Can Occur In Coal Mines Than A Fire—This Article Gives The Experience Of Its Author During Several Years In Fighting Mine Fires In Various Parts Of The Country, Outlining Precautions To Be Taken In Preventing And Extinguishing Them

By J. J. RUTLEDGE *

IT is strange, but apparently true, that bonfires have been made in some mines for the purpose of heating the miners' food or drink, and the coal or brattices have been ignited from such fires and, in several instances, methane accumulations have been ignited and explosions have resulted.

FIRES ORIGINATING FROM SHORT CIRCUITS ON ELECTRIC WIRES OR POWER LINES

One of the most frequent causes of mine fires during the last 25 years has been the short-circuiting of electric wires or power lines in coal mines. In one important coal field in Pennsylvania there were numerous fires reported which were uniformly of mysterious origin. An investigation by the district mine inspector developed that the fires originated primarily from falls of roof coal on the trolley line, knocking out the hangers and permitting the trolley wire to fall to the floor of the haulage way, the coal finally covering the wire to a depth of several inches. Of course, this threw out the breaker in the power plant outside the mine workings, and since the cause of the short circuit was not removed, when the circuit breaker was thrown in again by the night engineer in the power house it immediately was thrown out again. No one was sent into the mine workings to learn what had caused the breaker to be thrown out and to remove the cause before the breaker was thrown in again. After the night engineer had thrown in the breaker several times in succession, the arc from the ground on the trolley wire caused the coal to ignite and a mine fire resulted. In one large power house it was found that some one had roughened the jaws of the switch on the circuit breaker with a file so that it would be very difficult for any ground to throw out the breaker. These fires ceased when the jaws of the breakers were freed of the file notches and arrangments made to have the mine workings carefully inspected to determine the cause and location of the ground and to remove it before throwing in the circuit breaker.

Another cause is ignition of coal or methane by a fall of roof on power lines, especially when the three-wire system is in use. One very dangerous fire is believed to have originated from this cause. A grounding of the wires was caused by a fall and the mine workings were not carefully examined for cause of the ground before the breaker was thrown in and a fire resulted. A careful inspection of the power lines in the mine would have disclosed the ground and prevented the ignition of the coal.

Another very large fire originated at a small fan placed in the mine working at a considerable distance from the mine mouth, which was a drift opening. Whether the fire originated from the ignition of oil about the fan from open lights or from short circuiting was not definitely established, but undoubtedly the fire originated at the fan, and there would have been no fire if there had been no fan in the mine workings. Such fires may be expected to occur in the future if electrically operated blower fans are used to ventilate some of the single-entry work used to open up panel long-wall and similar methods of mining.

FIRES CAUSED BY USE OF LONG FLAME EXPLOSIVES

Black blasting powder is very apt to cause fires in mines working high-volatile coal, especially if gas feeders are prevalent and particularly if the coal is blasted off the solid. This fact has been demonstrated so often that, to the writer, it seems criminal to use black blasting powder for the production of coal under the conditions above named. Dynamite will also cause fires in high-volatile coal, especially if gas is present.

One of the worst mine fires the writer ever encountered was due to the use of gelatine dynamite in a soft-natured coal where gas was prevalent.

SPONTANEOUS COMBUSTION

Until about 30 years ago it was the practice in many mines in the Middle Western States to fork all coal as loaded into the mine cars in the mine, leaving the nut, pea, and slack coal in the mine to be gobbed. Especially was this practice prevalent in the machine mines. This fine coal, in many instances, ignited spontaneously and mine fires resulted. Usually when mine fires resulted from such accumulations of coal in mine workings, the burning coal was turned over by shovel until all the fire was extinguished, and allowed to cool, or the heated coal was loaded into mine cars and taken to the surface. In one large mine equipped with board puncher mining machines it was necessary to maintain a fire-fighting crew, consisting of a foreman and five other men, during the entire year. When gross weight laws were enacted and the miners' organization became strong and the companies were forced to pay the miners for all grades of coal mined, there were no further mine fires from this cause. In one important coal field in several old mines there were sealed fire areas, each of from 40 to 50 acres. They were sealed by thick masonry walls and frequently these walls were burst by the gases generated in the sealed area and the fire area had to be resealed.

EXTINGUISHING MINE FIRES

Before the introduction of artificial breathing apparatus and the installation of modern improved fire extinguishers in coal mines, it was customary to wet down, or turn over by the shovel, all mine fires, especially those originating from spontaneous ignition. In many cases the still hot coal or coke was loaded into mine cars and transported to the outside and thence to the dirt dump. This work required great courage and endurance, and the boast of many a mine foreman now living is that he "always loaded his fire out." That he did so was conclusive evidence that the fire had been extinguished. On the other hand, if the fire had gained such headway before it was discovered that it was found impossible to extinguish it, and the mine foreman was forced to seal it, this necessity was considered to be a reflection on the foreman's ability.

In some mines where room pillars had been kept too thin, the weight on them crushed the pillars and caused mine fires to originate in the crushed coal. Such fires were difficult to attack and often several rooms, and frequently a whole entry, had to be sealed in order to extinguish the fire.

What has just been mentioned pertains to fires originating from spontaneous ignition. There is, however, another kind of mine fire which is radically different from the sort just named. Feeders of methane are often met with in mining operations, in some coal seams, especially in the faces of headings and air courses in the virgin coal. Often lights on the miners' caps, or the flame from black powder shots, ignite these gas feeders, and if they are not speedily extinguished the coal seam is set on fire and a serious fire results. Sometimes, when these feeders are first ignited, the flame can be extinguished by brushing them out with the miner's jacket, or the flames can be beaten out

* Chief Inspector State Department of Mines, Baltimore, Md.

with a piece of wet canvas, but such means of extinguishing the flame are only practicable before the coal has been ignited.

Some mine foremen have resorted to the use of high explosives to extinguish the flame of the burning gas, but this is dangerous.

Use of Artificial Breathing Apparatus

About 1908 or 1909 artificial breathing apparatus first became available in this country for use in fighting mine fires. Had these devices been used for nothing else but fighting mine fires, the expense of their purchase has been justified a thousand-fold. Without doubt a great many mine fires that have occurred during recent years would not have been extinguished without loss of life and money, and many of them would not have been extinguished at all, without the aid of artificial breathing apparatus.

Use of Water for Fighting Fires

The most common means of fighting mine fires when they have attained any headway is by means of water thrown by hose and nozzle, the water being under as great pressure as it is possible to get it. Judgment should be used, however, in such matters. The writer recalls a fire in a mine in the Middle West which was located directly in the heart of a city of some thirty to forty thousand inhabitants, the fire being near the bottom of a vertical shaft about 600 feet deep. The city firemen were called upon and dropped their hose down the shaft and, without knowing anything about mining conditions, proceeded to fight the fire using water, the fire being very near the bottom of the shaft. Naturally the very great head the water had at that point made it almost impossible to control the hose and probably more damage was done by the water than by the fire.

Water Lines in All Live Entries a Fire Protection

Water lines of an ample size and connected to an ample water supply, preferably operating by gravity, should be laid in all live mine workings. Not only will these lines be useful in wetting coal dust but they will furnish an immediate supply of water under pressure for extinguishing *at the start* any mine fire that may occur. State mining laws should require the equipment of all mine workings with water lines. Like the telephone lines in coal mines, which had to be forced into mines by law, when an operator has once installed water lines in his mines he is not willing to be without them.

Use of Portable Chemical Fire Extinguishers to Extinguish Mine Fires

Portable chemical fire extinguishers are very useful in fighting mine fires, especially such types of apparatus as liberate carbon dioxide gas. The Babcock extinguisher and the hand grenade types of extinguisher have been used by the writer with success. Every large mine should have underground a large fire extinguisher mounted on a truck so that it can be taken to any point in the mine workings reached by the haulage tracks.

Small portable fire extinguishers, such as are carried on automobiles for fire protection, have been used during recent years in fighting mine fires, but such devices should be put into action by men wearing artificial breathing apparatus.

Use of Shale or Limestone Dust or Wet Sand to Extinguish Mine Fires

Dry sand has long been used successfully in extinguishing electrical fires, but its use as a direct application in stopping mine fires is, so far as the writer's experience goes, only of recent date. A fire had occurred in a mine where there was considerable gas. The main shaft, 600 feet in depth, was closed by a seal at the shaft mouth. The air shaft, where the fan was placed, was also closed by a seal. The mine was making considerable gas and the air shaft was the upcast and the fan stopped. A match was carelessly lighted in the fan, and the gas which was coming up through the fan was ignited, but it was so rich and so free of air that an explosion did not result, but numerous burning jets of gas appeared at the cracks in the covering of the air shaft. A stream of water was turned on the burning jets from a hydrant near by and quantities of sand from a mason's box adjacent to the fan. The wet sand effectually smothered the burning gas jets.

Use of Shale or Limestone in Fire Fighting

In the writer's judgment, much of the fire fighting in mines in the future will be done with shale or limestone dust or with fine wet sand. From experiments recently made the writer is satisfied that many of the mine fires he has fought in the past would have been better handled had finely ground shale or limestone been used in place of water.

Use of Explosives to Extinguish Burning Gas Feeders or Blowers

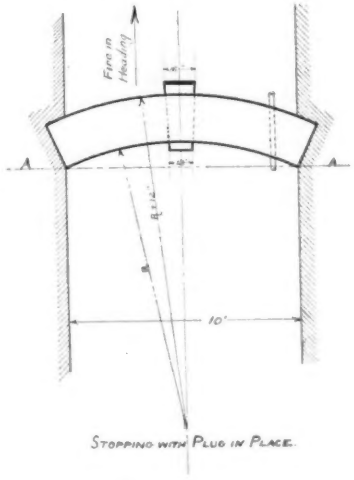
Some mining men with considerable experience in fighting mine fires have been in the habit of using the force developed by the explosion of a high explosive in the open, in contact with the burning feeder. The usual method of accomplishing the extinguishment of the blaze of the fire is to take a single stick of dynamite or permissible explosive, attach a piece of safety fuse, bearing a detonator, to the stick of high explosive, light the fuse and then throw it directly in the fire. The concussion generally extinguishes the flame of the burning feeder. This method of extinguishing burning gas feeders is not recommended, as it is not considered safe practice. It is merely referred to as the practice in some fields.

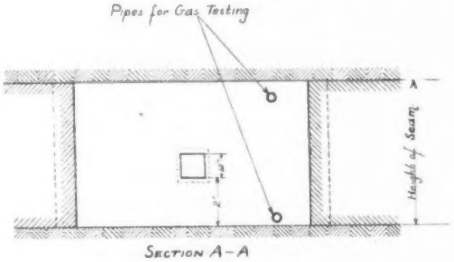
Sealing Burning Gas Feeders or Blowers

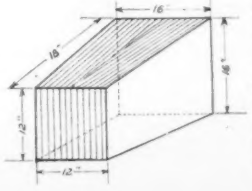
In general, it is extremely dangerous to seal burning gas feeders, unless the coal proper has been ignited and has developed such strength that the fire can not be extinguished by other means than sealing. By the use of water, wet canvas, shale or limestone dust or wet sand the burning feeders can usually be extinguished when attacked in time before the coal has become ignited and with the use of proper inspection of working places. After shots are fired all such ignitions of gas feeders should be discovered very soon after they become ignited and prompt effective means used to extinguish them.

Stoppings

The usual method of extinguishing mine fires that have gained too great headway to be extinguished by water is to seal or stop them up. Stoppings







Left—Detail of Built Up Wood Plug. To be left inside and drawn into place last by means of rope and wood-screw hook

Fig. 1
Stopping—Masonry or Concrete—To Seal Mine Fires

should be made of incombustible material, such as concrete, brick, tile, stone, or slate, but in many instances such material is not at hand and the fire must be sealed at once. In such cases temporary stopping made of several thicknesses of wet canvas can be hung across the room or entry, shutting the air current off the fire, and a few feet outbye this temporary stopping a board stopping can be erected. Into all stoppings pipes should be built, the outer end of the pipe being equipped with a good valve. Usually gate valves are used when available, as gas samples are more readily taken through valves of this sort than through globe valves. The pipe should be large enough to permit of the taking of samples of the mine air from behind the stopping and for the insertion of self-recording thermometers. These precautions are absolutely necessary. In times past fires have been shut in by seals, especially gob fires, and then after waiting some time the stopping appeared to be cool and those in charge of the mine deemed it safe to open the seal, and as soon as fresh air reached the fire area the fire, which had not been extinguished, kindled and, in many instances, burned more strongly than before. In other cases explosions resulted. Fire seals should never be broken until the management is reasonably sure that the fire is out, and this can only be known with a fair degree of certainty by an analysis of the samples of the gases from within the fire area and a definite observation of the temperature of these gases.

Stoppings can be made in emergencies of canvas or brattice cloth, which is kept thoroughly saturated with water; or they can be made with common boards plastered with mud or mortar or wood fiber. In cases where great speed is needed, the writer has made very good stoppings of plank placed about 6 or 8 inches apart and the spaces between the planks filled with mud.

Explosions During Fire Fighting Operations

So many explosions have happened during fire-fighting operations in the past that all possible precautions should be taken against such explosions, and it is believed that some of these are suggested in this paper.

Pennsylvania Plan (Bituminous)

One mining man with wide experience in fighting fires in gaseous mines working high volatile, dusty coal has, as a result of his experience, developed the following method of procedure:

Provided only the coal seam is on fire, and no burning gas feeders are present, he builds a temporary board stopping as close to the fire as the men can possibly work and then constructs a permanent masonry stopping as close to the temporary stopping as possible. He has hitches cut into the coal rib for the sides of the permanent stopping, which stopping is made arch-shaped, with the crest of the arch inbye. He leaves a hole 14″ x 14″ in the center of the permanent stopping and has a block of wood or built up beam, 12″ x 12″, in cross-section at one end and 16″ x 16″ in cross-section at the other, the entire plug being about 2 feet long. He has this plug ready, and as soon as the remainder of the permanent stopping is completed he pulls the plug, which has been left inbye the stopping, up into the hole and closes it effectually. Since the stopping is firmly anchored in the ribs and the crest of the arch is inbye, any pressure from the fire area tends to tighten the plug, and it is not easily or readily blown out. This plug can be forced inbye when it is desired to open the stopping. (See Fig. 1—Drawing of Plug Stopping.)

This method has been successfully used in fighting mine fires in a very gaseous region.

Air Lock

An air-lock of approved design is essential to safe and efficient fighting of mine fires. Such a device will afford opportunity of testing the artificial breathing apparatus and the physical and mental condition of the wearers of the apparatus before they enter the fire area. The air-lock will give the rescue men confidence, for they will know that if any accident occurs to them while in the fire area efficient aid will be close at hand. The air-lock furnishes a place where those directing the work of fire fighting can be stationed and thus be in close touch at all times with the rescue teams and the reserve rescue teams, which will usually be stationed immediately outside the air-lock in the fresh air.

The air-lock will also add to the efficiency of the work of fire fighting, since it can be moved up toward the fire from time to time as the work of fire fighting progresses, and in this way no backward steps will be taken and all ground won will be retained. This air-lock is a very important factor in fighting mine fires.

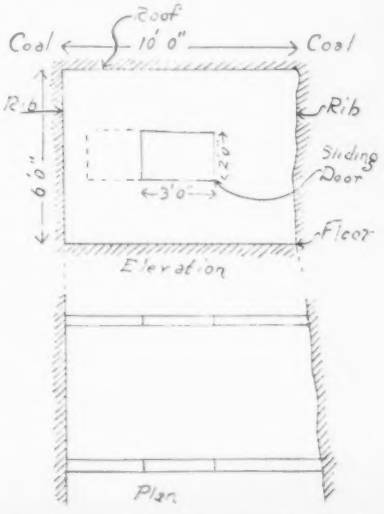


Fig. 2—Diagram Showing Construction of Air Lock

A certain fire was fought without the advantage of air-locks, and as the mine was somewhat gaseous and the coal high volatile in character, during the progress of the work the fire would be extinguished at one point and driven further inbye and toward the face of the entry and thence through the cross cut into another parallel entry, and within an hour the blaze of the fire would be right back where the hose was in use only one hour previously. If an air-lock had been installed this would have been avoided, since a good lock would have cut the flame off as it progressed up the entry.

If a gas feeder ignition has caused the fire, then an air-lock is absolutely necessary for fighting the fire.

Precautions to Be Taken While Fighting Mine Fires

There are several important precautions that should be taken while a mine fire is being fought. One or two experienced fire bosses equipped with approved flame safety lamps and canary birds should be stationed on the intake and the return of the area in which the fire is being fought. If the condition of the atmosphere is such as to require it, these men should wear either gas masks or artificial breathing apparatus. They should explore all working places inbye and outbye the fire area, especially blind rooms or faces of headings or air courses which have been driven ahead of the air. These men should exercise special vigilance if there have been any stoppings and resumption of the flow of the air current. Bodies of standing gas have been moved down onto burning fires by an interruption and then a resumption of the flow of the air current, without the knowledge of those men engaged in fighting the fire, and explosions have resulted. At one fire a very careful, conscientious observer suddenly found a three-quarter inch cap on the return area of a mine fire in a mine where the crew of fighters, utter strangers to the region, had been assured that there was no inflammable gas. But for the forethought of the man in charge of the fire fighters and the faithful work of the watcher a disastrous explosion might have occurred.

Breathing of Mine Fires

When active mine fires are sealed there is generally apparent by opening of the valves in the seals a movement of the fire within the seal outwards or a movement of the mine air into the sealed area. Some authorities have called this action a "breathing" of the mine fire, and during the time immediately succeeding the sealing of the area a careful

observation of the breathing process is absolutely necessary in order to ascertain what action is taking place behind the seal. No motion of the mine air into the sealed area should be permitted. Most of the explosions which have occurred during the sealing of mine fires and immediately after sealing have, in the opinion of the writer, been due to inflow of fresh air into the sealed area. A few explosions have resulted from the too rapid sealing of the burning gas feeders.

Careful, systematic readings of the temperature and pressure of the gases within an area in which a mine fire was sealed and while the surface of the ground 400 feet above was covered with 2 feet of snow, demonstrated that there is a relationship between the barometric pressure and the breathing of the gases within the sealed area where the mine fire was raging. Readings of temperature from within the sealed area and systematic sampling of gases from within the area are absolutely necessary.

Fires in Old Workings vs. Fires in Live Workings

Usually mine fires occurring in working rooms or in the faces of advancing headings or air courses are fires that can be attacked on one side—the outby—only. However, sometimes mine fires occur in old workings and the fire area can be circumscribed by seals. As a rule such fires must be sealed for a longer time before they are extinguished than fires in live or advanced workings. Very important data have been obtained from a study of these surrounded fires.

Sealing Mine Fires

There is considerable diversity of opinion among experienced fire fighters regarding the methods to be followed in sealing mine fires. Some advise sealing the return first; others insist on sealing the intake before the return; still others advocate the sealing of the return and intake simultaneously. Those who follow the last-mentioned plan are the most numerous. One mining man of wide experience in fighting fires in gaseous mines declares that a small fire in a gaseous mine should never be sealed up as, in his judgment, an explosion is sure to result. Many men of experience differ with this opinion, but there is some weight to be attached to this opinion. Let us, for example, suppose that a gas feeder has been ignited in the face of a heading or air course, and the gas is burning under pressure, but the coal has not yet become ignited. Let us further suppose that this feeder is coming from the coal face immediately behind a clay seam which has been exposed and broken by mining operations, and the gas is issuing under considerable pressure from an area in the coal face, say, 3 x 4 feet in extent, but not all the minute feeders have become ignited; a great many are burning, but at the outer edge of the area where the gas is escaping a number of the small feeders are not burning but are sending inflammable gas into the mine atmosphere. Now, if the feeders in the center of the gaseous area continue to burn they will burn up all of the gas issuing at that point, and the other gas, not burning, will become mixed with the mine air, moved out into the current, and become diluted and harmless by reason of its mixture with a large quantity of fresh air. After being allowed to blow for some time the pressure of gas in the feeder will diminish and the flame can be smothered by a wet cloth or extinguished by water or chemicals. But if, on the other hand, the fire is rapidly and immediately sealed by a strong, heavy masonry seal, the outer wall being built from floor to roof in a short period of time, the burning gas feeder will be shut in behind the stopping with some mine air containing oxygen and the nonburning gas feeders continuing to give off inflammable gas, and there will be found behind the stopping which seals the fire, before the flame is extinguished for want of oxygen, all the factors necessary to produce a mine explosion; moreover, they are so confined by the seal that the resulting explosion is sure to be of considerable violence. It is not strange that explosions result when mine fires are sealed under the conditions just mentioned. On the other hand, had the sealing of the fire been postponed until the pressure of the feeder had been allowed to subside, the burning flame would have burned the gas as fast as it was liberated and the gas not burned would have mixed with the air current and have been rendered dilute and harmless. Certainly these burning feeders should not be permitted to burn until the coal is ignited, but since the resulting fire will be very difficult to extinguish, it is a matter to be determined for each particular fire of this type just when the seal should be made. To the argument that such a course is dangerous and tends to loss of life and property, the reply can be made that there are numerous instances of burning feeders being quickly shut in by heavy masonry stoppings with explosions resulting almost immediately after completion of the seal. If such fires are sealed immediately after the discovery, then the seal should be constructed of a light though tight board stopping, provided with an aperture about 1 square foot in area, which aperture would be sealed some time after the stopping or seal proper was completed. By this procedure the fire area behind the seal would be freed of the dangerous mixture which is at the explosive limits of mine air and gas.

Time	CH_4	O_2	CO	CO_2	Pressure
2/5					
12.00 m.....	11.3	13.6	0.7	2.2	
4.45 p. m.....	11.7	12.3	1.0	2.7	
11.30 p. m.....	13.1	11.2	1.3	3.0	
2/6					
5.30 a. m.....	15.8	9.8	1.4	4.1	
12.00 m.....	18.1	8.9	1.4	4.5	.7 "
6.45 p. m.....	19.4	8.3	1.6	4.7	.65"
11.45 p. m.....	20.5	8.0	1.4	4.6	.70"
2/7					
8.45 a. m.....	23.1	7.0	1.6	5.2	.70"
5.30 p. m.....	24.9	6.4	1.4	4.7	1.2 "
11.05 p. m.....	26.6	6.2	1.5	4.5	2.2 "
2/8					
3.00 a. m.....	27.8	6.1	1.5	4.6	1.45"
12.00 m.....	29.9	5.5	1.5	4.6	1.8 "
5.50 p. m.....	30.7	5.2	1.4	4.6	1.6 "
2/9					
1.00 a. m.....	33.0	5.0	1.3	4.6	2.25"
11.00 a. m.....	34.5	4.7	1.3	4.6	1.2 "
6.10 p. m.....	36.5	4.3	1.1	4.3	0.9 "
10.50 p. m.....	35.5	4.2	1.5	4.6	1.05"
2/10					
3.45 a. m.....	33.6	5.7	1.3	4.0	
6.00 a. m.....	34.2	4.2	1.6	3.6	
6.45 a. m.....	38.7	3.9	1.3	3.7	

It is noted that the CH_4 increases and that the oxygen decreases; that the CO increases and this did increase up to a certain point, after which it began to decrease. The CO_2 increased uniformly. The pressure, also, is given in the last column, in inches of water, and this increased up to a certain point.

In fighting mine fires many who are inexperienced in such work become alarmed when the percentage of methane, as shown from samples taken within the sealed area, begins to increase rapidly, but a little reflection should convince them this is natural, since the oxygen as the main criterion is being constantly decreased and the CO_2 is increasing also, there is bound to be an increase in CH_4. As long as the CH_4 is kept above the explosive limit there will be no danger of an explosion.

Of course, the pressure should be taken into consideration also, since when the pressure declines and the temperature as well, and the oxygen is low, and there is no CO present, it is reasonable to assume that the fire is extinguished.

Figures from a recent fire showing increase in CH_4 and the decrease in oxygen, the increase in CO and the increase in CO_2, as well as the pressure on samples from sealed fire area

Usually when a fire area in a mine is sealed the oxygen content of the atmosphere within the sealed area begins to fall rapidly and ultimately reaches such a low percentage of oxygen that the atmosphere will not support combustion. On this fact depends the efficacy of sealing mine fires in order to extinguish them. If there is any methane present behind the seals, and especially if feeders or blowers within the sealed area are giving off methane, then the lessening of the amount of oxygen in the atmosphere behind the seals lessens the danger of an explosion if there is no leakage from the mine workings into the sealed area through defective stoppings, since the atmosphere within the seal is becoming deprived of most of its oxygen and hence will not be capable of giving off enough oxygen to the methane to form an explosive mixture. In other words, even though there may be considerable methane behind the seals and even some fire present, the mixture of air and gas will be so rich in methane that it can not cause an explosion if ignited. This has been demonstrated in many mine fires.

Behind the seal the oxygen content of the atmosphere is getting less and less, since no fresh air is supplied, and the fire consumes some of the oxygen as long as it burns.

Carbon monoxide is a product of incomplete combustion; that is to say, it is produced when (*Continued on page* 471)

EFFICIENCY IN MINE LIGHTING

Mine Lighting Has Not Kept Progress With The Tremendous Advance In Mining Methods—While Progress Has Been Made In Safety In Lighting, With The Increased Safety There Has Been A Decrease In The Volume Of Illumination

By D. C. ASHMEAD*

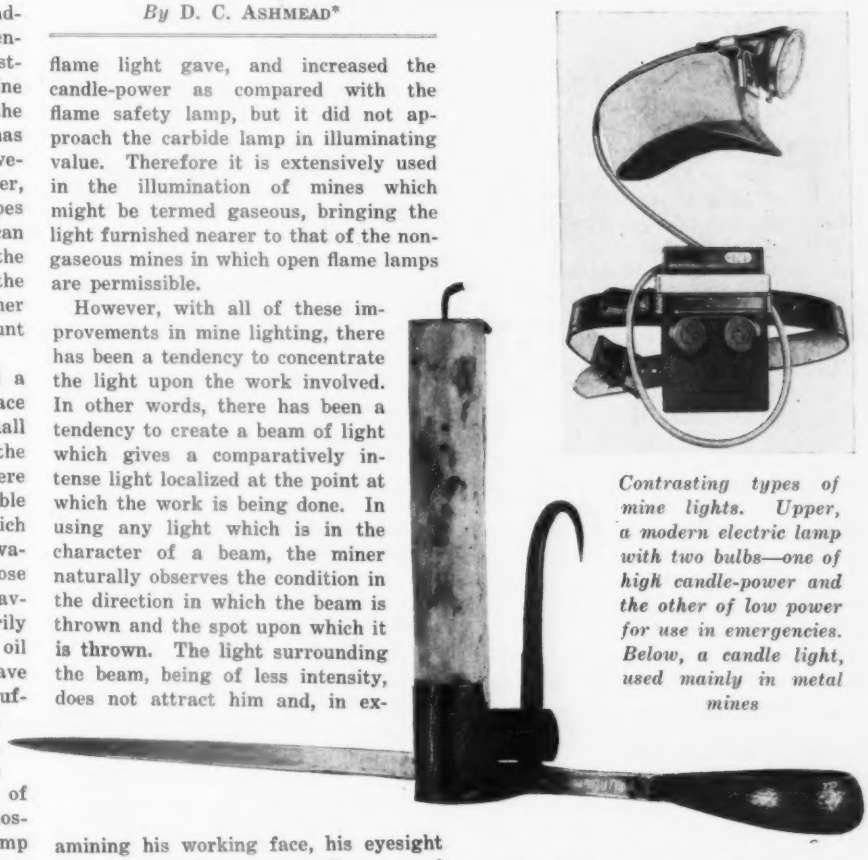
THERE have been tremendous advances in the methods of ventilation, drainage, haulage, blasting, mining and loading of coal, but mine lighting, from the viewpoint of the volume of illumination furnished, has not kept step with these other improvements. It has progressed, however, with reference to safety. Various types of lamps have been invented that can be used with comparative safety in the most gaseous of mines, but, with the increase of safety, there has been either a decrease or a standstill in the amount of illumination provided.

The old-fashioned candle produced a light which illuminated the surface fairly equally but threw a very small amount of light, not permitting the men to see the place in which they were working; therefore, they were unable to determine the conditions under which they were working by general observation but had to determine them by close examination, which is something the average mine worker will not ordinarily do. Following the candle, we had the oil open flame lamp which, although it gave more light than the candle, was not sufficient to throw adequate light for a visual examination of the working face, but still required the miner to give a close examination. About the time of the introduction of the oil lamp, or possibly before it, the flame safety lamp was introduced which was very necessary in gaseous places but, with its introduction, illumination was materially decreased. As a result, although safety from the standpoint of ignition of methane was greatly increased, safety due to the illuminating power was decreased because less light was given and the miner could only examine his working face with difficulty, and therefore was more subject to the dangers arising from the falling of roof and coal.

After the introduction of the flame safety lamp and its various improvements, the open flame carbide lamp was invented which was a very favorable contribution to mine lighting in non-gaseous mines, for it considerably increased the amount of illumination given the miner, and he was able to examine the working face more readily.

In the last few years there has been another improvement in mine lighting, and that is in the introduction of the electric head lamp. This lamp gave approximately the same safety that the old flame light gave, and increased the candle-power as compared with the flame safety lamp, but it did not approach the carbide lamp in illuminating value. Therefore it is extensively used in the illumination of mines which might be termed gaseous, bringing the light furnished nearer to that of the non-gaseous mines in which open flame lamps are permissible.

However, with all of these improvements in mine lighting, there has been a tendency to concentrate the light upon the work involved. In other words, there has been a tendency to create a beam of light which gives a comparatively intense light localized at the point at which the work is being done. In using any light which is in the character of a beam, the miner naturally observes the condition in the direction in which the beam is thrown and the spot upon which it is thrown. The light surrounding the beam, being of less intensity, does not attract him and, in examining his working face, his eyesight is concentrated upon a small area, and the relationship of one part of the roof with another is not brought out properly. As a result, he is not apt to observe conditions carefully in the working face and the roof immediately above him, therefore subjecting himself to dangers which might be avoided if proper lighting were provided.



Contrasting types of mine lights. Upper, a modern electric lamp with two bulbs—one of high candle-power and the other of low power for use in emergencies. Below, a candle light, used mainly in metal mines

Some authorities have figured out that the amount of light furnished the miner, under average conditions, is only about one-thirtieth of that furnished in a factory. Even when a beam of light is thrown upon the work which he is doing, the ratio is probably 1 to 10. Few manufacturers are yet satisfied with their illumination. This roughly shows the hardships under which the miner works due to insufficient light.

In order to surmount the difficulty of insufficient light, a great deal of thought has been given to an entirely new idea of mine lighting and that is flood lighting of the working face so that at all times the entire working face will be illuminated with practically the same intensity of light to a distance of about 15 feet back from the face, both the floor and roof illuminated as well as the actual coal face. With such a method of lighting, the miner will be able to observe readily the actual conditions under which he is working at all times. He will be able to notice loose rock hanging from the floor and will be able to take the necessary precautions to make his workings safe.

The writer was advised by the chief inspector of one of the coal mining states, that in certain mines in his jurisdiction a form of electric flood lighting had been used, and probably is still being used, at the working face which has proved successful; so much so that the number of fatalities at the working face at these mines has been decreased, according to his statement, 50 percent. The reason for this decrease is, as has already been stated, due to the increased visibility of the workings so that the miner can take the necessary precautions to make his place safe.

There is, however, an objection to electric flood lighting, from power lines, which is seri- (*Continued on page* 471)

*Mining Engineer, Wilkes-Barre, Pa.

THE NATION'S VIEWPOINT

A Digest Of The Expressed Opinions Of Leaders In American Affairs

THE British commission which came to America for the purpose of ascertaining why this country pays from two to three times the wages of Great Britain, and produces anything up to five times the British per capita output, gave nine major reasons in summing up their conclusions. These, as quoted in the *New York Times* and the *Wall Street Journal*, are:

"1. Promotion in America is by merit.

"2. America sticks to the principle of small profits and quick returns, and wealth is made by fine margins of profit on immense and rapid turnover.

"3. Rapid turnover is secured by simplification and cheapening of processes which necessitates less capital for a given output.

"4. America shows endless keenness in devising time saving and trouble saving appliances.

"5. The American employer is not hostile to high wages.

"6. American manufacturers cooperate by exchanging ideas.

"7. Americans are vigilant and acute in eliminating waste and in conserving time, energy, and space.

"8. American welfare methods double high wages in their stimulative effect by surrounding the workers with cleanliness and light and by seeking in every way to increase their conveniences and satisfaction.

"9. Americans encourage research with magnificent intelligence, scouring the world to obtain the best research brains."

Andrew W. Mellon, Secretary of the Treasury, in an address before the National Electric Light Association, said that both capital and labor are beginning to realize that they have a common interest in building up the great industries which are the sources of wealth for all, and that in America, with the opportunities which it offers and the constant transition from poverty to wealth, there is no place for class antagonism or class warfare. He further stated:

"Labor in this country, unlike labor in some of the European countries, long ago learned that no man can lift himself by his bootstraps; that an industry can not pay high wages, even under threat of strikes, unless that industry is prosperous; and that labor as well as capital must think in constructive terms and must act in harmony with, not in antagonism to, those great economic laws which work so inexorably whether we like them or not.

"Labor in America is not only maintaining a high standard of living but it is also banking part of its wages, as evidenced by the steady growth of savings deposits. It is organizing its own banks and buying shares in the corporation in which it works, and in this way the workers acquire a real partnership in the business in which they are employed.

"So gradually has this development been taking place that we do not realize its significance until it is pointed out to us by some outside observer. A delegation of British trade unionists recently visited this country and made a detailed study of industrial organization in America in order to learn the reasons for the high wages paid, the comparative lack of unemployment, and the better relation between employers and employes here as contrasted with Europe. This delegation has just returned home, and the substance of their report was that the friendly cooperation between employer and employe, the extensive use of machinery and of every practical labor-saving device, the initiative and courage of American business in seeking new methods and new markets, and the recognition of the folly of class hatred are mainly responsible for the great prosperity in America and for the existence of working conditions here, which are superior to conditions in any other country in the world.

"We have found in this country that by investing heavily in labor-saving machinery we can increase the productive capacity per capita of labor and also eliminate waste, which is such

Wallace Press-Times.

A Game Two Can Play

Wallace Press-Times.

But He Followed His Nose

Wallace Press-Times.

The Unwelcome Guest

Brooklyn Daily Eagle.

Eternal Vigilance Is the Price of Economy

N. Y. Evening World.

The Neighbor's Chickens

Washington News.

Fisherman's Luck

an important factor in the attainment of national prosperity. In this way we can pay high wages and still reduce costs, so that the finished products are within reach of the average man."

Julius H. Barnes, president of the United States Chamber of Commerce, in his address at their annual meeting, attributed America's economic supremacy to natural resources, habits of industry, and stable and sound government, particularly emphasizing the advantageous position of American labor. In part, he said:

"American organized labor this last year declared the measure of rightful compensation for the workers depended upon the production results of his labor. Thus was abandoned the old theories of a 'living wage' and the issue squarely joined with the European labor concept that the worker's daily performance must be restricted so that more days wages must be paid to accomplish a given result. Recently America has been visited by delegations from the British Associated Industries and by the London Mail's delegations of trades union leaders from the engineering trades. Their reports express amazement at the American worker's standard of possession and living. The conclusions of both British employers and British workers state that both the progress of the worker and the prosperity of the employers rest on increasing production.

"America assumes no self-complacent attitude when it speaks, with sober earnestness, of the lessons of its own experience and its own development, in this time of economic crisis in Great Britain. Vast and powerful trades unions, inclined to enforce the outgrown day's wage concept of restricted production, retard social progress in Great Britain along with national organizations of employers, slow to see the dividend and wage-earning possibilities of highly modern equipment."

William Green, president of the American Federation of Labor, at the celebration of Founder's Day, Carnegie Institute, Pittsburgh, delivered an address on "The Dream of Labor," in which he said:

"Both employers and employes should seek to promote industrial peace to settle their differences and arrange their wage scales without resort to industrial warfare. In all their transactions they should keep in mind the public welfare. A manufactured article should be of the highest and best quality and should be supplied to the public at prices that are fair and reasonable.

"It may be too much to expect that all differences may be eliminated in industrial relations between employers and employes, but in this enlightened age we are justified in entertaining the hope that because of a high sense of appreciation of public interest and because of their fair dealing between employers and employes, industrial disturbances may be reduced to a minimum.

"The workers should be encouraged to give their best efforts and the employer should seek to find ways and means by which this can be done."

Tulsa Daily World.

What Papa Saves Mama Spends

Senator James E. Watson, of Indiana, in addressing the Senate on the proposed bill to provide for prompt disposition of disputes between carriers and their employes, said:

"They (the railroad management and railroad employes) want something to be set up that will enable them, in a peaceful way, to conciliate their differences, to reconcile the inharmonious sides, and to bring peace to the railroad world.

"Not only that, but I am bold enough to prophesy that if this plan shall be adopted no railroad labor strike will occur in the United States; I am bold enough to prophesy that no great wage increases will be asked in the United States, because both sides will know that they are under trial if this bill shall be passed. I am bold enough to say that if this proposed legislation shall succeed it will become the standard by which similar machinery may be set up in the whole industrial world of America. Who does not wish for that glad day in the settlement of these disputes? So I think that when they come carefully to analyze the provisions of this measure Senators will agree with the statement I made at the outset—that this is the very best measure that can possibly be passed at the present time for the preservation of peace on the transportation systems of the country."

INCREASED PRODUCTION OF FULLER'S EARTH IN 1925

THE production of fuller's earth in the United States in 1925 was 206,574 short tons, valued at $2,923,965, it is announced by the Bureau of Mines, which is preparing a report on the subject, in cooperation with the Geological Surveys of Alabama, Florida, Georgia, Illinois, and Texas. This is an increase of 16 percent in quantity and 11 percent in value, compared with 1924. These increases were due in part to the reappearance of California and Nevada as producers of fuller's earth, though every state that reported production in both 1924 and 1925 showed an increase. The output was reported by 14 operators in seven states in 1925, namely, California, Florida, Georgia, Illinois, Massachusetts, Nevada, and Texas; in 1924 production was reported by 13 operators. California and Nevada reported no production in 1924, and Alabama, which was a producer in 1924, reported none in 1925. Georgia was the leading state in production in 1925, with Florida second and Texas third, as in 1924. These three states produced 85 percent of the total output. The average value per ton of fuller's earth was $14.15 in 1925, compared with $14.79 in 1924.

Fuller's earth is a term used to include a variety of natural substances that possess the property of absorbing grease or clarifying, bleaching, or filtering oil. They are mostly clay-like substances, though recently discovered material in the West, which is of different character, is said to be superior to the eastern fuller's earth. The original use of fuller's earth was in the fulling of cloth, but little of it is now used for this purpose. It is used almost exclusively in the bleaching or filtering of vegetable and mineral oils.

Until 1895, when fuller's earth was successfully produced commercially in Florida, the United States was entirely dependent on foreign supplies. The imports have, on the whole, been decreasing in recent years. In 1925, however, they were 8,015 short tons, valued at $111,295, an increase of 10 percent in quantity and 20 percent in value. Notwithstanding this increase the quantity of fuller's earth imported in 1925 was the smallest, except in 1924, since 1897.

The exports of fuller's earth are not separately shown by the Bureau of Foreign and Domestic Commerce, but five producers reported that in 1925 they exported 6,195 short tons of fuller's earth, which was a slight decrease from 1924.

The Geological Survey has issued a report on guides to ore in the Leadville, Colo., district.

REFINED PRIMARY LEAD PRODUCED IN THE UNITED STATES, 1923-25

	1923 (Short tons)	1924 (Short tons)	1925 (Short tons)
Domestic desilverized lead	291,760	299,348	345,429
Domestic soft lead	190,749	203,615	260,560
Domestic desilverized soft lead	61,332	63,449	48,932
	543,841	566,407	654,921
Foreign desilverized lead	74,481	124,086	112,048
Total refined primary lead	618,322	690,493	766,969
Antimonial lead	14,190	20,787	19,667

APPARENT CONSUMPTION OF REFINED PRIMARY LEAD IN THE UNITED STATES
(Refinery stocks disregarded)

	1923 (Short tons)	1924 (Short tons)	1925 (Short tons)
Supply:			
Stocks in bonded warehouse, Jan. 1	.....	2,617	5,045
Imports of pigs, bars, and old metal	21,099	12,247	7,021*
Production	618,322	690,493	766,969
	639,421	705,357	779,035
Withdrawals:			
Exports of foreign lead:			
From warehouse	48,736	76,758	98,564
In manufactures, with benefit of drawback	12,526	15,275	9,211†
Exports of domestic lead	1,999	5,332	4,955
Stocks in bonded warehouse, Dec. 31	2,617	5,045	8,162
	65,878	102,410	120,892
Apparent consumption	573,543	602,947	658,143

IMPORTS AND STOCKS OF LEAD IN ORE AND BULLION

	1923 (Short tons)	1924 (Short tons)	1925 (Short tons)
Imports of lead in ore and matte	33,441	47,660	44,481
Imports of lead in bullion	80,748	77,751	70,627
Remaining in warehouse Dec. 31:‡			
Lead in ore and matte	38,016	51,737	52,942
Lead in bullion	40,153	47,504	45,863
	Value		
Average selling value in cents per pound	7.0	8.0	8.7

* Includes 622 tons of "old, reclaimed, and scrap."
† Figures for the last quarter not available.
‡ Some part of this may have been smelted and refined and thus be included in the quantities given above as "foreign desilverized lead."

PRIMARY LEAD SMELTED OR REFINED IN THE UNITED STATES, 1923-1925, BY SOURCES, IN SHORT TONS

Source	1923	1924	1925
Domestic ore:			
Alaska	400	582	699
Arizona	8,828	9,372	10,281
California	5,168	2,305	4,148
Colorado	23,885	25,491	31,855
Idaho	127,797	123,709	123,363
*Illinois	1,286	1,089	474
*Kansas	20,207	12,895	15,001
*Kentucky	66	201	96
*Missouri	169,323	191,501	208,547
Montana	18,345	21,226	22,008
Nevada	8,044	8,070	10,978
New Mexico	1,638	2,263	3,782
*Oklahoma	59,602	56,017	78,487
Oregon	47	.....	6
South Dakota	.....	2	2
*Tennessee	1,020	985	436
Texas	40	27	31
Utah	104,678	119,318	166,844
*Virginia	.....	1,582	2,179
Washington	2,008	2,057	2,802
*Wisconsin	601	1,973	2,889
Undistributed	691	15	2
Zinc residues	362	1,320	1,541
	554,036	582,000	686,451
Foreign ore:			
Canada	3,632	4,633	10,676
Central America	18	30	6
Europe	139	328	470
Mexico	18,867	33,328	31,107
South America	1,461	7,663	4,496
Other foreign	171	403	269
Foreign base bullion:			
Mexico	50,193	77,701	65,024
	74,481	124,086	112,048
Grand total	628,517	706,086	798,499

* The lead produced by these states is nonargentiferous or soft lead. In 1924 about 642 tons of nonargentiferous lead was also derived from Colorado, and 179 tons from New Mexico; in 1925, 1,383 tons were derived from Colorado ores.

OUTPUT OF REFINED PRIMARY LEAD AND LEAD PIGMENTS IN 1925

(*See charts on opposite page*)

THE production of refined primary lead in the United States in 1925, from domestic ores, amounted to 654,921 short tons, valued at $113,956,000, according to statistics compiled by the Bureau of Mines. These figures represent the greatest quantity and highest value for any year in the history of the lead industry of the country. As compared with 1924, they show an increase of 16 percent in quantity and 26 percent in value. The value of the output is based on the average selling value per pound as reported by the lead smelters.

Missouri ranked first in the source of lead smelted or refined; Utah held second place; and Idaho was third. Mexico was the chief source of foreign ore refined in this country.

The apparent consumption of refined primary lead in the United States in 1925 amounted to 658,000 tons, as compared with a consumption of nearly 603,000 tons in 1924.

Lead Pigments Sold in 1925

Total sales of lead pigments in 1925, as reported to the Bureau of Mines by producers, were slightly less (2 percent) than in 1924; sales of the individual pigments, however, were greater, with the exception of those of white lead ground in oil, which decreased 17 percent.

The average selling value of each pigment showed a substantial increase. The value of white lead, dry, is based on the average selling value of the domestic shipments, although some export shipments were made at a lower price owing to the drawback allowance of the duty paid on the foreign material used in their manufacture.

STREAM POLLUTION AND COAL MINING INDUSTRY

(*Continued from page* 425)

with the various states where coal is being mined rather than await the evil day to the industry when an outraged public secures the passage of legislation which will not only seriously hamper the industry but pass on the bill for increased cost of production to the consumer in the price of coal placed in the bin?

Leonardo da Vinci, scientist, engineer, artist, and one of the greatest thinkers of the Italian Renaissance, said: "Men are of three kinds—those who see for themselves, those who see when they are shown, and those who neither see of themselves nor when they are shown."

Discussion:

Howard N. Eavenson, *Consulting Engineer, Pittsburgh*, Pa., in discussion of Mr. Crichton's paper said:

Of course, everybody in the coal business is interested in a general way in the water, and they all know the necessity of keeping the water as pure as possible, but this Indian Creek decision has certainly awakened more interest. My opinion is that mine drainage stream pollution is considerably more important than Mr. Crichton seems to think. After a careful reading of the Supreme Court's decision it is apparent that all of the Pennsylvanians here would have quite a job figuring out what streams the decision could not be made to apply to. That is one of the very serious phases, and I think one that the coal industry does not yet appreciate. Another matter that comes up in connection with that is what is going to happen to the drainage from the mines after the mines are worked out and the coal is abandoned. I do not think that the drainage is going to stop. I wonder whose job it would be to keep the water purified after the mine has been abandoned. I have been told by a great many men, and it is also my own opinion, that the water from the abandoned mines is worse than the water from the mines in operation. Of course, there is the matter of sealing the abandoned mines. This is possible in some, but not possible in others. Just what the idea would be to take care of that contingency, I am unable to say.

There is another item that Mr. Crichton touched on that possibly needs a little elaboration. A great many of the railroads on which I have traveled operate on streams of no mine pollution, still they treat their water. In fact, I imagine there are more railroads treating their water than are not. Some have to treat the natural drainage.

There is no doubt, however, that the coal industry and all of the other industries are facing a proposition where this matter will have to be taken care of. We have reached a stage, not only in Pennsylvania but in eastern Ohio and northern West Virginia, where the streams will have to be kept from being polluted. There are those which are pure, others can be purified, while others are beyond purification. The whole problem is one that demands concerted action, and if the coal industry does not take some constructive move they are going to be put to an expense in Pennsylvania such as will close half of the mines which are operating. It is high time that the coal industry realizes this fact and takes some action toward finding a solution that will prevent pollution.

James F. Callbreath, *Secretary of the American Mining Congress*, called attention to the recent decision of the District Court of Idaho, which has laid down a principle which demands not only that the water be kept in a state where it could do no damage, but that it must be returned to the stream as pure as when it was taken from the stream. He stated that such a ruling would absolutely close up the lead industry of Idaho, which state now produces about half of the lead produced in the United States. He urged the metal and coal operators to join with each other in bringing about the fundamental principles as to whether an industry may be permitted to survive or whether it must close. Once having established that principle, it is difficult to believe that the decision of the United States District Court can be final, as there are some places where without the industry there would be no need for water. Whole towns are dependent upon the industry for a livelihood. Mr. Callbreath urged the convention to propose some plan to meet the situation, to be referred to a later meeting, which would consider the subject in conjunction with Government officials.

Howard I. Young, *General Manager of the American Zinc, Lead & Smelting Co., Mascot, Tenn.*, said:

"Our company is operating in the state of Montana. The stream we are mining upon in the mountainous country makes it impossible to give a clear overflow from our settling pond. The water contains absolutely nothing injurious to plant or animal life, but we are now in Federal court with a suit brought by some hundred residents along the creek trying to enjoin us and shut down our operations. It is really important that the coal industry and the metal industries cooperate in this big question of stream pollution."

Resolution Adopted

The session closed with the appointment of a committee to study the problem, draft resolutions, and make recommendations to be referred back to the American Mining Congress for consideration and action. This committee is composed of Messrs. Howard N. Eavenson, consulting engineer, Pittsburgh, Pa.; Howard I. Young, general manager, American Zinc Lead and Smelting Company, Mascot, Tenn.; and J. J. Rutledge, state mine inspector, Baltimore, Md.

POTASH IN 1925

PRODUCERS of potash in the United States report that the output in 1925 amounted to 51,544 short tons of crude potash salts, containing 25,439 short tons of potash (K_2O), according to the Bureau of Mines. Sales by producers amounted to 52,823 short tons of crude potash containing 25,802 short tons of K_2O—equivalent to just about one-tenth of the potash content of salts imported during the year. The domestic potash materials sold were valued at $1,204,024 f.o.b. plants. About 31,000 short tons of crude potash, with an available content of 10,000 tons of K_2O remained in producers' stocks December 31, 1925. The production was from natural brines in California, dust from steel plants in Pennsylvania, and distillery residue from molasses at a plant in Maryland Sales from stock on hand were made by one cement company, but there was no production from cement dust in 1925.

MAGNESIUM SALTS IN 1925

THE production of magnesium salts from natural sources in 1925 in the United States was 85,158,000 pounds, valued at $1,253,110, according to James M. Hill, of the Bureau of Mines.

Five companies produced 62,227,000 pounds of magnesium chloride, valued at $911,440, from bitterns. Of this quantity 59,788,000 pounds was solid chloride, which sold at $0.0148 a pound, and 2,439,000 pounds was in liquid form from 23° to 36° Baume, which sold at $0.0109 a pound.

Four companies produced magnesium sulphate to the amount of 22,931,000 pounds, which sold for $0.0149 a pound. About 90 percent of the sulphate was made from salt works bitterns and the balance from natural magnesium sulphate.

MINE PRODUCTION OF CRUDE PLATINUM

THE total production of crude platinum in the United States in 1925 was 343 ounces, according to reports from mine operators compiled by James M. Hill, Bureau of Mines. This output is more by 92 ounces than the purchases by refiners reported in a recent statement by the Bureau of Mines.

Mine operators in California in 1925 produced 312 ounces of crude platinum, which was sold for $36,000, or $115 an ounce, and 19 ounces of crude platinum was produced in Oregon and sold for $2,100, or $111 an ounce. The United States Geological Survey has informed the Bureau of Mines that over 12 ounces of crude platinum was reported produced by Alaska mines in 1925.

REFINED PLATINUM AND ALLIED METALS IN 1925

PLATINUM refiners in the United States in 1925 purchased 47,548 troy ounces of crude platinum from domestic and foreign sources, or 17,123 ounces less than 1924, according to J. M. Hill, of the Bureau of Mines. Purchases of the domestic material were distributed as follows: Alaska 24 ounces, California 160 ounces, Oregon 60 ounces, other States 7 ounces, a total of 251 ounces, or 59 ounces more than in 1924. Purchases of foreign crude platinum were: Australia 4,852 ounces, Canada 2 ounces, Colombia 37,962 ounces, Russia 4,473 ounces, other localities 8 ounces, a total of 47,297 ounces, or 17,182 ounces less than in 1924.

The refined platinum metals recovered from crude platinum, from ore and concentrates, and from gold and copper refining, amounted to 49,643 troy ounces, of which 11,759 ounces is believed to have come from domestic materials.

MOLYBDENUM IN 1925

ALTHOUGH the United States has thousands of molybdenum deposits, ranging in size from those which produce only a few flakes of molybdenite, to those in which there are millions of tons of ore, only two molybdenum mines were operated during 1925, according to the Bureau of Mines. The market has not yet grown sufficiently large to warrant the operation of other mines. The two which operated are well equipped and are owned by companies which make their own molybdenum compounds to be sold to the steel trade. In Colorado the Climax Molybdenum Co. operated throughout the year at Climax, about 15 miles, by rail, northeast of Leadville. In New Mexico, the Molybdenum Corporation of America operated its mine in Sulphur Gulch, about seven miles east of Questa. Together the companies produced 97,665 tons of ore, from which was made 864 short tons of concentrates carrying 72.7 to 85 percent molybdenum sulphide equivalent to 1,154,065 pounds of molybdenum (metal). A few tons of molybdenite are used each year for making chemicals, and a few thousand pounds of molybdenum is used in the electrical industry, but the bulk of the production is used in machine steels.

EXPERIMENTAL FURNACE FOR STUDY OF REFRACTORIES

There are numerous problems concerning the service conditions of open-hearth refractories on which it is difficult to get data from commercial furnaces. The Bureau of Mines plans to erect a small experimental furnace of 600 or 800 pounds capacity for the purpose of collecting data on problems similar to the following: The rate of saturation of roof brick with slag; the effect of rate of heating upon roof brick structure; the effect of insulation upon refractories, and the abrasion of port ends as affected by design and by gas velocities.

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SANITATION IN ALABAMA COAL TOWNS

A Recent Survey Of Conditions Indicate Splendid Cooperation Between State Agencies And Coal Companies In Eliminating Disease And Establishing Sanitary Conditions

THE sanitation of mining towns probably receives more serious consideration in the Alabama coal-mining district than in most of the other coal fields of the country, according to the Bureau of Mines, which has made a sanitary survey in that State in cooperation with the United States Public Health Service. This is due to the semi-tropical climate which makes possible a large number of communicable diseases not found in colder climates. Such diseases in the past have been the cause of large financial loss by the absence of employes from work due to sickness. This condition was so serious at one time that some of the larger companies had to carry 165 men on the pay roll to keep 100 men working. In a few instances mines were forced to close down until an epidemic was over. These epidemics were without exception due to diseases that are now recognized as preventable. The financial loss from having to carry such a large force of men in order to keep the mines at work, and the risk of being shut down by an epidemic for an indefinite period, has led the larger companies to install health departments and to take steps to prevent the occurrence of such diseases. The small companies that are not financially able to maintain health departments adopt many of the methods put into operation by the larger companies.

The State endeavors to aid this work in every way possible, and as funds are made available by the Legislature, the State Board of Health extends its work by establishing permanent county health units in the mining counties. The work for the past few years has been energetically pushed by the larger mining companies and the State Board of Health through the county health units, until all mines of any size are carrying on some health work, and in the larger companies the work has been extended to cover all phases of health and welfare work. It is only the very small mines that are not actively engaged in sanitary work, and these feel they are not financially able to carry on sanitary work other than could be conducted in the individual homes. There is decided improvement in health conditions, as indicated by a decrease of 35 men per 100 necessary to keep 100 men working, as well as the fact that in the last few years no epidemic has closed any mines in the State. The importance of the work has been clearly established, and there is reason to believe that conditions in the future will be still better.

In the towns where the employes own their own homes, poor sanitary surroundings are found, for it is often very difficult to induce the householder to maintain the premises in a sanitary condition. The towns that are entirely owned by the companies are more sanitary because measures advocated by the companies' sanitary departments or the county health department can be more easily enforced.

The civic progress is good. Most of the towns have well kept commissaries, dancing pavilions, modern schools and well constructed churches. The majority of the schools are modern, well kept buildings. However, in the smaller villages the buildings are not modern and in some instances are overcrowded, poorly designed and inadequate. The schools usually have a playground that is ample in size; some in the larger towns having regular playground equipment. The business district of the towns consist as a rule of one company commissary.

The schools are inspected by the camp physicians and the county health officers in counties that have such officers. Once each year all school children are examined. The parents of defective children are notified of defects found and requested to have them corrected.

Copies of the full report of this survey, designated as Serial 2746, may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

CAUSES OF MINE FIRES

(*Continued from page* 464)

there is not sufficient oxygen to yield complete combustion. Carbon monoxide is usually generated in sealed areas containing mine fires; especially when coal, slate, or shale, or even rock is burning under heavy falls. Such fires have in times past been the most difficult to extinguish and have in many instances been reopened before they had been extinguished, with great property and wage loss, as well as loss of life, in many instances. The investigative work on mine fires by Messrs. Paul, Burrell, and Jones, of the United States Bureau of Mines, and more recently the investigations of Dr. W. P. Yant, of the same organization, have developed the important diagnostic fact that if no traces of carbon monoxide are found in the sample of atmosphere drawn from within the sealed area, then we can be reasonably sure that there is no flame in the sealed area, and if other details, such as temperature of atmosphere and absence of pressure of the gases from within the sealed area, are favorable, then it is safe to break the seals. This result of the investigations of the bureau is a noteworthy step in advance in the work of safely and efficiently fighting mine fires and, in the writer's opinion, is a distinct contribution to our scientific knowledge of mine fires. When the oxygen content of the gas within the sealed fire area is from 5 to 7 percent and there are no traces of carbon monoxide, the fire is probably extinguished.

EFFICIENCY IN MINE LIGHTING

(*Continued from page* 465)

ous. In order to obtain the illumination necessary, electric wires at present have to be strung into each place, sockets put into position. There is some danger of sparks forming in the sockets. There is danger at all times of roof falls breaking the circuits causing sparking which may ignite gas and coal dust and, if such a fall occurs on the main line, it would mean that the mine is put in total darkness and there would be difficulty in removing the men from the mine.

However, there is now under consideration, experimentation and development, a new light which will be movable in character, that is, it can be carried without much trouble from one part of the working surface to another if necessary, removed in times of blasting from the face to the nearest crosscut, and that will produce a non-glare light of somewhere between 100 and 200 candlepower. With two of these placed in a working face, at opposite sides, shadows can be eliminated, and the roof and floor observed at all times. If a fall of rock or coal occurs, which would damage the lamp, it means that only one lamp is put out of commission, and the mine would be endangered in no way due a flame or spark coming in contact with either the coal dust or the mine gases.

The lamp itself will be a safety lamp, and be able to meet any requirements of a lamp of this character.

With the introduction of this new type of mine lighting, a great advancement in illumination and safety will be given to the mine worker, and the conditions, as far as light is concerned, under which he works, will approach nearer and nearer, as time goes by, to the conditions under which the man in the factory works, and greater efficiency in labor can be looked for, together with a material saving in the most important of all things, that is, human life.

NEWS OF THE MINING FIELD

A Résumé Of The Activities Of The Mining Industry And Items Of Interest In The Field

Says New Discoveries Equal Depletion in Tri-State Zinc Ores

Extensive drilling campaigns being carried on in the Tri-State district are undoubtedly developing sufficient ore to take the place of the mines that are being cut out, said Otto Ruhl at a meeting of the Tri-State section of the American Zinc Institute at Picher, Okla.

Just how long the Picher camp or any other camp in the district will last is a hard question to answer, Mr. Ruhl said, and best answer would only be a guess. One thing that must be taken into consideration as to the probable life of the district is the increased demand being made upon the district. Fifteen years ago the old Webb City-Joplin district was producing only 6,000 tons of ore, he said, while today the Tri-State district is producing two and one-half times as much. If the demand increases as much in the next 15 years as it has in the past 15, then it will be somewhat difficult to keep the production up, but he said he believed that it would be a long time before there was a scarcity of ore here.

What will be the longest tunnel in America and the fourth longest in the world is being constructed in the Cascade Mountains in Washington for the Great Northern Railroad. This great bore will be 7¾ miles long, and its construction will require three years. The Moffat tunnel in Colorado, which will be completed next year, will be 6 miles long. Driving of the Cascade tunnel is progressing from both ends, and later work will be proceeding on four faces, as a shaft of four compartments, 8 feet by 24 feet, is being sunk 2¾ miles from the east end of the tunnel to intersect the line of the tunnel and provide two additional headings. When this shaft is completed the work will be carried on in both directions from it.

Deepest Telephone in the world

The deepest telephone in the world was installed recently at the bottom of Tamarack No. 5 shaft of Calumet & Hecla Consolidated, at Calumet, Mich. The shaft is 5,300 feet deep, vertically, the deepest in the United States. The connecting cable weighs almost 4 tons, averaging a pound and a half a foot, and is anchored to shaft timbers.

Ray-Nevada Merger Approved

Acquisition of the properties and assets of the Ray Consolidated Copper Co. by the Nevada Copper Co. was approved by stockholders of both companies at special meetings on May 26. The consideration was $46,157,685 of Nevada Consolidated Copper Co. 15-year 5 percent debentures, to be dated July 1, 1926, with interest adjustment from or to the date of actual transfer of the properties.

Under the terms of the sale all obligations of Ray Consolidated are assumed by Nevada Consolidated. The officers and directors of the Ray organization were authorized to distribute the proceeds from the sale on a pro rata basis among the stockholders of Ray Consolidated, following which the latter organization will be dissolved.

To Film "The Story of Copper"

The Kennecott Copper Corp. has allotted $25,000 for the production of an educational film illustrating the production of copper, to be made in cooperation with the Bureau of Mines.

United Verde Shares Employes' Losses in Bank Failures

Following the failure of two banks in the Jerome district of Arizona recently, the United Verde Copper Co. took it upon themselves to bear half of the losses sustained by those of their employes who were depositors. Although there was no obligation whatever on the part of the company to take this action, the following from the letter sent to its employes involved shows the interest this company has in their welfare: "Mr. Charles W. Clark and Mr. W. A. Clark, Jr., president and vice-president, respectively, of the United Verde Copper Co., * * * extend to you and the members of your family who lost money in the failure of the Bank of Jerome and the Commercial Trust & Savings Bank their sincere sympathies and their checks for one-half of your losses."

The Lake Superior Mining Institute will hold its 1926 meeting on the Gogebic iron range, although definite plans have not yet been formulated. E. W. Hopkins, of Ironwood, is president of the institute, and A. J. Yungbluth, of Ishpeming, is secretary.

Announcement has been made of the formation of the American Chrome Products Corp., Butte, Mont., to develop the chrome deposits near Columbus, Mont., known as the Benbow group. The claims are within 6 miles of the Mystic Lake power plant of the Montana Power Co. and close to deposits of coal, limestone. natural gas, soda, and potash. It is planned to erect a concentrator and plants to manufacture ferrochrome and the bichromates of soda and potash.

James H. Rowe, of Butte, is president of the newly formed company; Peter G. Grant, of New York, vice-president; Paul A. Gow, manager of North Butte-Tuolumne Merger, vice-president; and W. D. Kyle, attorney, of Butte, secretary-treasurer.

A joint meeting of the State Mining Committee of the California Development Association and the Department of Mines and Mining of the Sacramento Chamber of Commerce was held at the Sacramento Chamber of Commerce, May 10.

The discussions at this conference brought out a survey of some of the most important mining problems and laid emphasis upon the necessity of continued cooperation in solving these problems, and the importance of utilizing to the fullest extent the possibilities which are presented through the vast mineral deposits in California, both the precious metals and the industrial minerals.

As a result of the general discussion the following resolutions were passed endorsing the efforts of the American Mining Congress to protect the prospector and mine operators within the national forests and to cooperate in every way possible, favoring a Federal law on high-grading; and to consider methods used in other states in taxing mines and mining properties which will relieve the heavy taxation labored under by mine operators.

During the next few months the Department of Mines and Mining will intensify its efforts in attempting to focus public interest on the mining industry and in working out a practical program for assisting in the development and utilization of all classes of minerals.

There will be an important conference on October 11, under the auspices of the Department of Mines and Mining, working in conjunction with other civic bodies, for the purpose of bringing together the

representatives of the mining industry from the entire Pacific coast region to discuss their problems and work out a program to be carried out during 1926 and 1927.

Canada Principal World Source of Asbestos

It is estimated that Canada furnishes more than 80 percent of the world's production of asbestos, and 80 percent of the Canadian output is produced by the Asbestos Corporation of Canada (Ltd.) and three companies controlled by American capital, according to the Department of Commerce. The Asbestos Corporation, owning the newest and largest mill, is at present the largest single producer, but the three American companies produce each an important proportion of the total.

During the last quarter of 1925 seven of Canada's asbestos companies agreed to merge. This amalgamation, designed to stabilize prices, eliminate price cutting, and effect economies in production by unified operation, has been in the process of negotiation for several months. The constituent firms will be operated by the Asbestos Corporation (Ltd.), the other member being Black Lake Asbestos & Chrome Co. (Ltd.). Thetford Vimy (Ltd.), Consolidated Asbestos (Ltd.), Federal Asbestos Co., Maple Leaf Asbestos Corporation (Ltd.), and Asbestos Mines (Ltd.), the seven companies operating 17 mines in Quebec. The total output in 1924 of the merging companies amounted to 102,995 tons, or 45½ percent of the Canadian production, and sales aggregated 102,677 tons, valued at $3,041,498. The 1924 production of companies which will continue to operate independently totaled 123,302 tons, of which 122,895 tons, worth $3,577,432, were sold or shipped.

Mining and Milling of Mica

The constant demand for information on mica, and numerous new developments in the preparation and utilization of this material, have justified a broad study and preparation of a report by the Bureau of Mines covering all technical phases of the industry. This study has been undertaken by W. M. Myers, associate mineral technologist, attached to the Nonmetallic Minerals Station, New Brunswick, N. J. Mr. Myers is collecting data and establishing contacts with mica producers.

New List of Commercial Laboratories

For the information of numerous inquirers, lists of chemists, assayers, and laboratories equipped to make mineral analyses have recently been prepared by the Bureau of Mines. Separate lists have been compiled for the eastern, southern, western, and middle western states. In each instance the information is given as to the general nature of analyses which the laboratory is prepared to make. The Bureau of Mines is not allowed to make commercial analyses, nor can it undertake to recommend or favor any particular laboratory or individual, nor to guarantee the results of assays or analyses made by the laboratories named on the list. All of the laboratories listed are using the methods recommended by the American Society of Testing Materials for the analysis of coal and coke.

Hearing on Magnesite Tariff June 21

The Tariff Commission will hold a hearing on June 21 at Washington, in its investigation of the magnesite tariff, covering the differences in the cost of production of crude and caustic calcined magnesite in the United States and abroad. This investigation was instituted in August, 1923, following applications received from foreign producers requesting a reduction in the rate of duty on dead-burned magnesite. Subsequently, applications have been received from two American producers seeking an increase in the rate of duty on crude and caustic calcined. Almost the entire domestic production of crude magnesite comes from California. A small amount was formerly produced in the State of Washington.

Industrial Accident Prevention Conference

An official call of the industrial accident prevention conference to be held at the Mayflower Hotel, in Washington, D. C., July 14, 15, and 16, 1926, has been issued to the governors of the various states by Secretary of Labor James J. Davis. Invitations will be sent to the principal agencies, public and private, interested in the development of more efficient and specific methods of industrial accident prevention.

In his letter of invitation to the governors, Secretary Davis said: "There is no adequate system of industrial accident reporting in the United States, but a conservative estimate indicates that the fatal industrial accidents probably exceed 23,000 per year and that nonfatal injuries total 2,500,000 per year. The number of days labor lost is estimated to be 227,169,970 per annum, and the wage loss exceeds a billion dollars. I am advised by experts that fully 85 percent of these accidents are preventable. In fact, many establishments and some industries, by close application of safety methods to the 'danger spots' in their industrial plants, have been able to reduce their accidents by a percentage almost as great as this. The cooperation of all of the states and all other accident reporting organizations will be sought to the end that attention may be called not in general terms but by specific plans for the more general adoption of safety methods which have been so successful in a few instances."

United States and Great Britain Cooperate in Mine Safety Research

Under the program of cooperative research between the United States Bureau of Mines and the British Safety in Mines Research Board, Dr. H. F. Coward, an English investigator, well known for his researches on the ignition of gases and the propagation of gaseous explosions, is working at the Pittsburgh, Pa., mining experiment station of the Bureau of Mines, on a number of scientific problems connected with ignition and explosion of gases. G. W. Jones, E. J. Meiter, M. D. Hersey and H. P. Greenwald, of the Bureau of Mines technical staff, have been assigned to work with Dr. Coward.

Good progress is being made, and the results of the investigations will be embodied in joint publications of the Bureau of Mines and the Safety in Mines Research Board. Dr. R. V. Wheeler, is in charge of the British mine safety research work and Dr. George S. Rice is in charge of the Bureau of Mines work.

In exchange for Dr. Coward's services, Dr. R. Thiessen, of the Pittsburgh experiment station, has been in Sheffield, England, for some time assisting the Safety in Mines Research Board in its researches on the spontaneous combustion of coal and the inflammability of coal dust.

Arrangements have also been made, under the cooperative agreement, for the exchange of information on two particular groups of researches in which the experimental difficulties are great and the necessity for obtaining accurate information is pressing. These researches deal with the inflammability of coal dust and with the measurement of the degree of fineness of dust particles.

The coal industry came in for its share of consideration at the annual meeting of the United States Chamber of Commerce at Washington. At the meeting of the Natural Resources Group on May 11, Walter Barnum, of New York City, president of the Pacific Coast Company and chairman of the research committee of the National Coal Association, presented a paper on the subject, "Self-Government in the Coal Industry." Mr. Barnum pointed out that there wasn't any coal problem from the standpoint of the public, and contended that the bituminous industry is remarkably efficient, when consideration is taken of inherent difficulties, and that it should be left to work out its own problems.

"If we have governmental interference," said Mr. Barnum, "the sequence will be regulation and strangulation.

With royal commissions, government wage negotiations, subsidies and the like, the British Nation has put its good right hand into a private machine which it can not operate, and that hand is being mangled. We want no such disaster in our country. To make sure thereof coal should be rescued from the toils of politics into which the Government during the war hurled it.

"During the last 20 years there is no period, even including the disturbed years, when the amount paid by the American people per ton to the producer for the nation's coal supply was not lower than the amount paid per ton at the mines in England, France, Germany, or Belgium. To state it in another way, this nation has constantly for 20 years and longer, and is today, enjoying the lowest bituminous coal price in the world."

The following resolution was adopted by the Chamber: "Regulation and control of the coal industry are proposed in divers ways by bills pending before Mr. Barnum presented a resolution which was approved by the Natural Resources meeting, and which prompted the Chamber to adopt the following: "Regulation and control of the coal industry are proposed in divers bills pending before Congress. We therefore consider it appropriate to reiterate the position of the Chamber of Commerce of the United States in opposition to proposals which have for their object the control of industries by governmental agencies."

Coleraine Operation Resumes

A new company organized at the Coleraine Colliery Company, under the management of G. B. Ames and Ralph W. Rymer, trustee, has taken over the lease formerly held by the A. S. Vanwickle estate on anthracite properties at Beaver Meadows, Pa., which were abandoned several years ago, houses and breaker disposed of, under the impression that the veins were exhausted. The present operators have not only erected a new $100,000 steel breaker, electrically equipped, but have made additional investments in regard to new openings and new mine equipment. The new breaker stands 1,500 feet west of the old Coleraine colliery which was razed in 1924.

In cooperation with the Carnegie Institute of Technology, a special examination for fire bosses, assistant mine foremen, and mine foremen will be held by the Pennsylvania Department of Mines on July 12, 13, and 14 at the Pittsburgh educational institution.

Although the dates will be of special convenience to the students of the Carneige Tech summer course in coal mining which ends on July 10, the announcement points out, the examinations are not restricted to the summer students and any coal miner who feels qualified may take the tests.

The four weeks summer course for young coal miners to be given by Carnegie Institute of Technology in cooperation with the Pittsburgh experiment station of the United States Bureau of Mines will open on June 14.

For the first time in 30 years, or since the organization of the United Mine Workers, the total tonnage of all the open-shop coal mines of the former Pnttsburgh union district has exceeded the total tonnage of the union mines of the district for that week. This conclusion was reached after a survey made by the Pittsburgh Coal Company showed that the open-shop tonnage of three companies was 77,700 tons for the week ending April 24.

According to Charles O'Neil, secretary of the Central Pennsylvania Coal Producers' Association, 80 percent of the coal now being produced in the central Pennsylvania bituminous district is being mined on a nonunion basis. "Cambria is the only county among the 14 comprising the district that has retained the union scale, and it is believed the mines there will soon be obliged to follow the other counties in order to sell in competition with sections east of the Ohio River," says Mr. O'Neil.

"Safety Day" will be celebrated in West Virginia at Huntington on August 31, when mining men from all over the state will gather for a first-aid and mine-rescue contest. A banquet will be held in the evening, at which it is planned to have prominent mining men speak.

Treating Oil Shale With Chemicals

A chemist at Stuttgart, Germany, has worked out what he claims is an entirely new and unusual method of extracting valuable products from oil shale. It is based on treating the shale with chemicals, rather than with heat, and results in production of silicic acid, hydrated or calcined alumina, exide of iron, carbon bisulphide, carbonic acid, and coal. By further treatment it is claimed that the coal can be made to yield oil.

"Illinois Petroleum"

"Illinois Petroleum" is a new press bulletin series which is to be issued twice quarterly by the Illinois Geological Survey, in order to make available the results of investigations bearing on the exploration and recovery of oil and gas in Illinois. It will give information on recent oil developments, new areas deserving investigation, new horizons worthy of testing, and new technical methods which should help to increase or maintain present production. In the early numbers, articles will appear regarding the use of the core bit for cable tools, the advisability of testing deeper horizons in certain parts of Wabash County, Ill., and developments in Illinois during the first part of 1926.

The Department of Justice has completed its investigation of the recently announced plan for the acquisition by the Standard Oil Co. (of New York) of the assets of the General Petroleum Corp. The facts developed by the investigation do not indicate the prospect of a present violation of the Sherman Act or a contempt of the dissolution decree of 1911. The reason for this conclusion is that upon investigation it was found that the business of the two companies were clearly complementary and not competitive.

New Superintendent for Petroleum Experiment Station

N. A. C. Smith, of Worcester, Mass., has been appointed superintendent of the petroleum experiment station of the Bureau of Mines at Bartlesville, Okla. He succeeds E. P. Campbell, who recently resigned to accept a position with the Pure Oil Co. Mr. Smith has been connected with the Bureau of Mines since 1918 and has been stationed at Washington, Pittsburgh, and Bartlesville. He was formerly in charge of the petroleum laboratory at the Pittsburgh experiment station, and since July 1, 1925, has been assistant superintendent of the Bartlesville station.

U. S. Iron and Steel Exports High in April

Exports of iron and steel from the United States amounted to 194,449 gross tons in April, a gain of nearly 15 percent over the March shipments, according to the Iron and Steel Division of the Department of Commerce. The April figures represents an unusually large amount, being greater than the total exports for any month since May, 1923, if we except January, 1924, when exports were augmented by reconstruction materials for Japan, scheduled to reach that empire prior to the resumption of the tariff duties which had been temporarily waived after the earthquake and fire disaster.

The total exportation for the first four months of the current year was 695,659 tons, which is greater by 25 percent than foreign shipments in the corresponding period of 1925.

The development of a new steel product, a light type of structural material which can be used in dwellings just the

same as heavier beams are used for skyscrapers, has been announced by the Jones & Laughlin Steel Corp. A new electrically operated rolling mill has been erected at Woodlawn, on the outskirts of Pittsburgh, to produce the material, which is known as "J. & L. Junior."

Officials of the corporation, experts and engineers who tested the product, said it marked an important step in building, especially of dwellings, and for roofs and floors. This material is claimed to resist fire and earthquake, and while of light weight for its size, has greater strength for its weight than any steel produced in the history of the industry.

W. M. Weigel to Handle Nonmetallics

W. M. Weigel, mineral technologist, has been designated specialist for the Division of Mineral Resources and Statistics, Bureau of Mines, on the following subjects: Sand and gravel, silica, talc and soapstone, and the fertilizer materials phosphate rock, potash, and nitrates. Mr. Weigel will write the separate chapters of "Mineral Resources of the United States," devoted to these materials.

ENDOWMENT COMMITTEE FOR ENGINEERING FOUNDATION

AT the meeting of the Engineering Foundation in New York May 19, W. L. Saunders, president of the United Engineering Society, announced that in response to a request from the Engineering Foundation last December and repeated suggestions from the Founder Societies of Civil, Mining, Mechanical, and Electrical Engineers, the United Engineering Society had appointed an endowment committee to seek an increase of funds for the Engineering Foundation and Engineering Societies Library.

The personnel of this committee is made up of nominees of the four societies and other members, as follows:

Ex officio: W. L. Saunders, president, United Engineering Society, chairman; L. B. Stillwell, chairman, Engineering Foundation; Sydney H. Ball, chairman, Library Board.

Nominees of American Society of Civil Engineers: Charles F. Loweth, Chicago, chief engineer, Chicago, Milwaukee & St. Paul Railway; H. deB. Parsons, New York, consulting engineer; Ralph J. Reed, Los Angeles, chief engineer, Union Oil Co.

Nominees of American Institute of Mining and Metallurgical Engineers: D. W. Brunton, Denver, chairman, Board of Consulting Engineers, Moffatt Tunnel; J. V. N. Dorr, president, the Dorr Co. (metallurgical, chemical, and sanitary process equipment), New York; Thomas Robins, New York, president, Robins Conveying Belt Co., member Naval Consulting Board.

Nominees of American Society of Mechanical Engineers: J. W. Lieb, New York, vice-president and general manager, the New York Edison Co.; Wynne Meredith, San Francisco, member of firm Sanderson & Porter; E. A. Simmons, New York, president, Simmons-Boardman Publishing Co.

Nominees of American Institute of Electrical Engineers: Calvert Townley, New York, assistant to president, Westinghouse Electric & Manufacturing Co.; H. A. Lardner, vice-president, J. G. White Engineering Corporation, New York; E. Wilbur Rice, Jr., Schenectady, honorary chairman, General Electric Co.

Members at large: Charles F. Rand, New York, past president, American Institute of Mining and Metallurgical Engineers; James H. Perkins, New York, president, the Farmers' Loan & Trust Co., financial adviser and custodian of securities for United Engineering Society; H. Hobart Porter, New York, of Sanderson & Porter, and president, American Water Works & Electric Co.

A gift of $100,000 by Mr. Edward Dean Adams to the Engineering Foundation and Engineering Societies Library was announced by Mr. Saunders. Mr. Adams was guest of honor at the meeting and in appreciation of his service as vice-chairman of the Engineering Foundation for 10 years was elected an honorary member for life.

GASES FROM BLASTING IN SULPHIDES

WARNING of the hazard of poisonous gases that may be produced in certain metal mines as the result of blasting in massive sulphides is given by the Bureau of Mines. Large amounts of sulphur dioxide may be generated in blasting in heavy sulphides, particularly in dry working places where dust has settled on the walls. There also appears to be danger from sulphide dust explosions when blasting in such places. The deadly gas, hydrogen sulphide, is also likely to be produced in blasting in heavy sulphides. Water in drill holes appears to increase the amount of hydrogen sulphide generated when blasting in such places. Ventilation currents should be arranged in such a manner that there is no possibility of men getting caught in gases from blasting in heavy sulphides. In the past, a number of lives have been lost and other men incapacitated by the toxic effects of gases produced in blasting in massive sulphides.

From evidence gathered from several mines working in heavy sulphides, it appears that occasionally there may be an explosion of the sulphide dust in stopes. Settled dust is apparently stirred up by the first shot of a round, and then the dust cloud is ignited by a succeeding shot. When this happens large quantities of sulphur dioxide are mixed with the other gases from blasting, and undoubtedly more serious results are likely to occur when men are caught in such an atmosphere.

It has been supposed that the sulphur dioxide alone was responsible for the casualties, but the sampling of gases from blasting in heavy sulphides at certain mines, by engineers of the Bureau of Mines, indicates that hydrogen sulphide may be a contributing factor.

Sulphur dioxide is irritating to the lungs and to the eyes and is readily detected by smell. Experimental data are lacking as to its physiological effects and the amounts necessary to cause death. In tests conducted by the Bureau of Mines, it was impossible to remain in an atmosphere containing slightly less than 0.02 percent sulphur dioxide for more than one minute, due to eye irritation and effect on the membranes of the nose, throat and lungs.

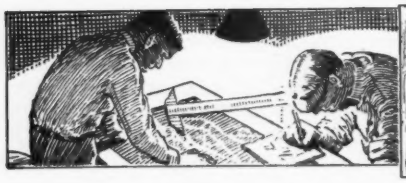
Hydrogen sulphide is detected by smell when present in low concentrations. When present in large enough quantities to be acutely dangerous, the gas dulls the sensitiveness of the olfactory nerves and it can not be smelled. The odor of hydrogen sulphide also may be masked by sulphur dioxide.

Some gelatin explosives contain sulphur, but extensive sampling in making an investigation of the gases from blasting in country rock with such explosive by the Bureau of Mines indicated that under similar conditions the amount of sulphur gases from the explosive did not exceed 0.003 percent of sulphur dioxide and no hydrogen sulphide.

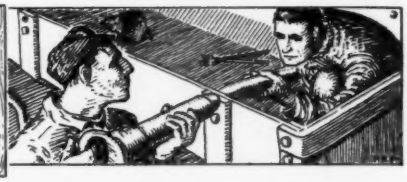
Sulphur from the heavy sulphide ore probably combines with oxygen of the explosive to form sulphur dioxide. It is also likely that in some cases atmospheric oxygen enters into the reaction. The reaction by which hydrogen sulphide is generated is not as well understood.

The report of this investigation is contained in Serial 2739, "Gases from Blasting in Heavy Sulphides," by E. D. Gardner, G. W. Jones, and J. D. Sullivan, copies of which may be obtained from the Bureau of Mines, Department of Commerce, Washington, D. C.

A report on its research work has been issued by the Bureau of Standards. It says the Copper and Brass Research Association maintains a research associate at the bureau to study metal roofing. A prominent steel company has a research chemist at the bureau to study and devise new methods of working and treating iron and steel. A metal organization supports an associate at the bureau to study and experiment on the wear resistance of bronzes.



WITH THE MANUFACTURERS



Methane Recorder

The Mine Safety Appliances Co., of Pittsburgh, Pa., announces the perfection of a continuous Methane Recorder, shown for the first time at the Coal Equipment Exposition of the American Mining Congress in Cincinnati.

The use of this instrument promises to be of inestimable value in eliminating coal mine explosions. It will provide an absolutely continuous record of the amount of Methane in any split of air and serve as a guide for regulating the fans so that the concentration of the gas may be kept well below the explosive limits at all times.

New Shovel-Type Transformer Has Oil-Tight Tank

A new shovel-type transformer has just recently been designed and placed on the market by the Westinghouse Electric and Manufacturing Co., the outstanding characteristics of which are a heavy end frame construction, a welded sheet metal tank, and additional bracing to prevent the transformer from sliding around inside the tank. This transformer is used advantageously in applications that require a transformer having oil-tight tank and bushings.

Redesigned Relay

The General Electric temperature overload relay known as the TC-121 has been redesigned. This relay has two heating elements connected in each two phases, so that complete protection is provided for single, two or three-phase motors. On direct-current circuits, the heating elements are connected on each side of the line.

The improved relay is known as the form C, or TC-121-C.

Milburn Markets New Welding Torch

The Alexander Milburn Co., Baltimore, Md., has perfected the Type J-Jr. Torch. This is a sturdy, compact torch said to give a high degree of efficiency and economy. The torch uses the same tips as are supplied with the standard larger torches and is adaptable to all classes of welding. It uses low and comparatively equal pressures of oxygen and acetylene.

One-Piece Dust-Proof Meter Case

A mahogany-veneered, one-piece Micarta meter case has been designed by the Westinghouse Electric and Manufacturing Co. for standard watthour meters.

New A-C Starter

A new starter announced by the General Electric Co. bears the type designation CR-7055-A-1. It is a reversing primary resistor starter for squirrel-cage induction motors.

Two three-pole line contactors are provided with this starter. These contactors are electrically and mechanically interlocked and are mounted back-to-back on the panel. A magnetic time interlock provides a predetermined definite time of from one to three seconds between the closing of the line contactor and of the accelerating contactor.

Two-point starting is provided by a resistor designed to conform to Electric Power Club classification No. 16. A temperature overload relay with an external resetting mechanism furnishes overload protection.

Among the recent new industrial control devices being marketed by the General Electric Co. are a new resistor terminal, an external relay reset, a relay installing wrench and a new relay mounting panel. With the exception of the new resistor terminal, the new equipment is designed to facilitate the use of temperature overload relays.

The branch office of The Timken Roller Bearing Service and Sales Co., located at 1033 Cathedral St., Baltimore, Md., was closed May 1st. The service requirements of Timken customers in this territory will be supplied through the Richmond, Pittsburgh, and Philadelphia branches.

Mr. T. F. Rose, formerly assistant branch manager of the Chicago branch of the Timken Roller Bearing Service and Sales Co., has been appointed branch manager of their Cincinnati branch.

The Timken Roller Bearing Service and Sales Co. has appointed Mr. H. C. Sauer, branch manager of their Detroit branch. Mr. Sauer was formerly assistant branch manager at Cleveland.

Fred G. Rumball, formerly branch manager of the Kansas City branch of The Timken Roller Bearing Service and Sales Co., has been promoted to the position of sales engineer, automotive division, of The Timkin Roller Bearing Co. Mr. Rumball will have his headquarters at Cleveland, with Edgeley W. Austin, assistant manager of sales.

R. F. Fiske, for several years manager of the R. D. Nuttall Co.'s eastern office at Philadelphia, has been appointed sales manager in place of Q. W. Hershey. John E. Mullen, of the home office sales force, has been made assistant sales manager.

T. R. Sanders, 180 Milk Street, Boston, Mass., has recently been appointed as district representative for Foote Bros. Gear & Machine Co., of Chicago.

Mr. Sanders will cover Rhode Island and the eastern half of Massachusetts and operates under the direction of the New York office in charge of J. R. Shays, Jr.

The Sullivan Machinery Co. announces the appointment of Mr. Charles B. Officer, hitherto assistant to the president on engineering matters, to the position of chief engineer of the company in charge of engineering matters with regard to new machinery or changes in existing designs. Mr. Officer is a graduate of Yale University (Sheff., 1912, M.E. 1915) and has been connected with the company ever since his graduation.

The Chicago office of The Ohio Brass Co., Mansfield, Ohio, was on May 1, moved to 1714 Fisher Building, 343 South Dearborn St.

Broderick & Bascom Rope Co., St. Louis, Mo., have issued a beautiful bulletin in commemoration of their fiftieth anniversary. It is called "1876—Our Golden Jubilee—1926," and is a special number of their house organ, "The Yellow Strand."

"The Effect of Surface Materials on Steel Welding Rods" is the title of a booklet just issued by the Chicago Steel & Wire Co., Chicago, Ill. The book contains information on Gas Filler Rods, Metallic Arc Electrodes Parts 1 and 2, Weldite Catalog and Automatic Welding.

The Carnegie Steel Co., Pittsburgh, Pa., has just released their ninth edition of a booklet on Steel Cross Ties.

The May issue of the Explosives Service Bulletin, published by du Pont Powder Co., is devoted to an article by H. H. Hamilton on the Detection and Cure for Stray Electrical Currents.

BUYER'S DIRECTORY

ACETYLENE, Dissolved (Or in Cylinders)
Prest-O-Lite Co., Inc., 30 E. 42nd St., N. Y. C.

ACETYLENE GAS
Prest-O-Lite Co., 30 East 42nd St., New York City.

ACETYLENE GENERATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ACID, SULPHURIC
Irvington Smelting & Refining Works, Irvington, N. J.

AERIAL TRAMWAYS
American Steel & Wire Co., Chicago and New York.

AIR COMPRESSORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

AUTOMATIC CAR CAGES
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

AUTOMATIC FEEDERS, GRAVITY
G. M. Johnson Mfg. Co., Jeannette, Pa.

AUTOMATIC (Mine Doors, Truck and Electric Switches)
American Mine Door Co., Canton, Ohio.

AUTOMATIC SWITCH THROWERS
American Mine Door Co., Canton, Ohio.
G. M. Johnson Mfg. Co., Jeannette, Pa.

BATTERIES (Storage, Gas Welding, Cutting, Dissolved Acetylene)
Prest-O-Lite Co., 30 East 42nd St., New York City.

BATTERY SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

BEARINGS (Roller)
Hyatt Roller Bearing Co., Harrison, N. J.

BELTING (Conveyor, Elevator, Transmission)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BELTING, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

BINS (Coke and Coal)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

BIT SHARPENERS
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.

BLACK DIAMONDS
R. S. Patrick, Sellwood Building, Duluth, Minn.

BLASTING POWDER
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLASTING SUPPLIES
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

BLOWERS, CENTRIFUGAL
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BLOWPIPES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

BOND TERMINALS
Amer. Mine Door Co., Canton, Ohio.

BREAKERS (Construction and Machinery)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

BUCKETS (Elevator)
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CABLES
American Steel & Wire Co., Chicago and New York.

CABLES (Connectors and Guides)
American Mine Door Co., Canton, Ohio.

CABLEWAYS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

CAGE (Safety Appliances)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

CAGERS, AUTOMATIC
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
G. M. Johnson Mfg. Co., Jeannette, Pa.
Mining Safety Device Co., Bowerston, Ohio.

CAGES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
G. M. Johnson Mfg. Co., Jeannette, Pa.

CAGES (Self-dumping)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAGE STOPS AND LOCKS
Mining Safety Device Co., Bowerston, Ohio.

CARBON AND BORTZ
R. S. Patrick, Sellwood Building, Duluth, Minn.

CARBON BURNING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CARBON RODS AND PASTE FOR WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

CAR DUMPERS (Rotary)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR HAULS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CAR STOPS (Automatic)
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

CAR WHEEL BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CASTINGS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAIN RAIL CAR HAULS
G. M. Johnson Mfg. Co., Jeannette, Pa.

CHAINS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, AUTOMOBILE ENGINE
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, COAL CUTTING
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CHAINS, DRIVE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, FRONT END
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, OILING
Morse Chain Co., Ithaca, N. Y.

CHAINS, POWER TRANSMISSION
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SILENT (Rocker-Joint)
Morse Chain Co., Ithaca, N. Y.

CHAINS, SLING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHAINS, SPROCKET WHEEL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

CHILI MILL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CLAMPS (Trolley)
Ohio Brass Co., Mansfield, Ohio.

CLUTCHES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CLEANING MACHINERY
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL COMPANIES
General Coal Company, Land Title Bldg., Philadelphia, Pa.
Lehigh Coal & Navigation Co., Philadelphia, Pa.
Thorne, Neale & Co., Philadelphia, Pa.

COAL CRUSHERS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL CUTTERS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL HANDLING MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL LOADERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

COAL MINING MACHINERY
Goodman Mfg Co., Halsted St. and 48th Pl., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

COAL MINING PLANTS
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

COAL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COKE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

COMPRESSORS, AIR
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

COMPRESSORS, MINE CAR
Ingersoll-Rand Co., 11 Broadway, New York City.

CONCENTRATORS (Table)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CONCRETE REINFORCEMENT
American Steel & Wire Co., Chicago and New York

CONDENSERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

CONTROLLERS
Goodman Mfg. Co., Halsted St. and 48th Place, Chicago, Ill.

CONVERTORS, COPPER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Traylor Engineering & Mfg. Co., Allentown, Pa.

CONVEYOR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

CONVEYORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, BELT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, CHAIN FLIGHT
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, COAL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS AND ELEVATORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CONVEYORS, PAN OR APRON
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CONVEYORS, SCREW
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CORE DRILLING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

COUPLINGS, FLEXIBLE
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

CROSSINGS AND CROSSOVERS
Central Frog & Switch Co., Cincinnati, Ohio.

CRUSHER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

CRUSHERS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

CRUSHERS, COAL
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

CRUSHERS, SINGLE & DOUBLE ROLL
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CRUSHING PLANTS, COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

CUTTING APPARATUS, Oxy-Acetylene, Oxy-Hydrogen
Oxweld Acetylene Co., 30 E. 42nd St., New York City.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

DECARBONIZING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

DESIGNERS OF PLANTS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DIAMOND CORE DRILL CONTRACTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.

DIAMOND DRILLING CARBON
R. S. Patrick, Sellwood Building, Duluth, Minn.

DIAMONDS, BLACK (See Carbon and Bortz)
R. S. Patrick, Sellwood Building, Duluth, Minn.

DOORS, AUTOMATIC MINE
American Mine Door Co., Canton, Ohio.

DOUBLE CRIMPED WIRE SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

DRIFTERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLING, DIAMONDS FOR
R. S. Patrick, Sellwood Building, Duluth, Minn.

DRILLS, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS (Blast Hole)
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, CORE
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ELECTRIC
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILLS, HAMMER
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRILLS (Hand Operated Coal)
Ohio Brass Co., Mansfield, Ohio.

DRILLS, PNEUMATIC
Ingersoll-Rand Co., 11 Broadway, New York City.

DRILLS, PROSPECTING
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.
Keystone Churn Drill Co., Beaver Falls, Pa.

DRILLS, ROCK
Diamond Machine Co., Monongahela, Pa.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

DRILL STEEL SHARPENERS
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

DRIVES, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

DRUMS (Hoisting, Haulage)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

DUMP CARS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

DYNAMITE
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

DYNAMOS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.

ELECTRICAL APPARATUS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.

ELECTRIC HOISTING MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

ELECTRIC LOCOMOTIVES
General Electric Co., Schenectady, N. Y.
Goodman Mfg. Co., Forty-eighth Place and Halsted St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC MINE SUPPLIES
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

ELECTRIC WIRES AND CABLES
American Steel & Wire Co., Chicago and New York.

ELECTRICAL SUPPLIES
General Electric Co., Schenectady, N. Y.

ELEVATORS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATORS, BUCKET
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ELEVATOR MACHINERY
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

ENGINES, GAS AND GASOLINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES (Hoisting and Hauling)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

ENGINES, OIL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.

ENGINEERS
H. R. Ameling Prospecting Co., Rolla, Mo.

EXPLOSIVES
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., 934 King St., Wilmington, Del.

FAN DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

FANS, VENTILATING
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

FEEDERS (Crossover, Kickback, Rotary and Dump)
Mining Safety Device Co., Bowerston, Ohio.

FEEDERS (Hand operated)
Mining Safety Device Co., Bowerston, Ohio.

FEEDERS, ORE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

FEEDERS (Semi-automatic)
Mining Safety Device Co., Bowerston, Ohio.

FILTER WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

FLOTATION MACHINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FLOTATION OILS
Hercules Powder Co., 934 King St., Wilmington, Del.

FLOW METERS
General Electric Co., Schenectady, N. Y.

FLUX, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

FORGINGS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

FROGS AND SWITCHES
Amer. Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.

FURNACES, ROASTING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

GAS (Cutting, Welding)
Prest-O-Lite Co., Inc., 30 E. 42d St., New York City.

GAS (Nitrogen, Oxygen)
Linde Air Products Co., 30 E. 42nd St., New York City.

GAUGES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GEARS
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

GEARS, BEVEL
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GEARS, REDUCTION
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GEARS, HERRINGBONE
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GEARS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

GEARS, SPUR
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

GEARS, WORM
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.
Jeffrey Mfg. Co., 958 N. Fourth St., Columbus, Ohio.

GEARS, WORM WHEELS
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros., Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

GENERATORS AND GENERATING SETS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

GENERATORS, ACETYLENE
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GLOVES, ASBESTOS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

GOGGLES, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

HANGERS (Insulated Trolley)
Ohio Brass Co., Mansfield, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

HEADLIGHTS, ARC AND INCANDESCENT
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Ohio Brass Co., Mansfield, Ohio.

HERRINGBONE GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

HOIST DRIVES
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

HOISTS
American Steel & Wire Co., Chicago and New York.
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, AIR
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, ELECTRIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Diamond Machine Co., Monongahela, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, PORTABLE
Ingersoll-Rand Co., 11 Broadway New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

HOISTS, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

HOISTS (Room and Gathering)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

HOISTING ROPES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

HOSE, AIR AND STEAM
Ingersoll-Rand Co., 11 Broadway, New York City.

HOSE, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

INSULATORS, FEEDER WIRE
Ohio Brass Co., Mansfield, Ohio.

INSULATORS, SECTION
Amer. Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Porcelain)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Third Rail)
Ohio Brass Co., Mansfield, Ohio.

INSULATORS (Trolley)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

INSULATED WIRE AND CABLE
American Steel & Wire Co., Chicago, Ill.
Roebling Sons, John A., Trenton, N. J.

KILNS (Rotary)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

LAMPS, ARC AND INCANDESCENT
General Electric Co., Schenectady, N. Y.

LEAD BURNING APPARATUS, Oxy-Acetylene, Oxy-City Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

LOADERS (Mine Car)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADERS, PORTABLE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOADING BOOMS
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

LOADING MACHINES
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

LOCOMOTIVES, ELECTRIC
General Electric Co., Schenectady N. Y.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

LOCOMOTIVES, RACK RAIL
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

LOCOMOTIVES, STORAGE BATTERY
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MACHINERY, TRANSMISSION (Power)
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MANIFOLDS, OXYGEN
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

MILLS, ROD & BALL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MILLS, STAMP
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINE CAR BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

MINE DOORS, AUTOMATIC
American Mine Door Co., Canton, Ohio.

MINING & METALLURGICAL MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

MINING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

MINING MACHINES
Goodman Mfg. Co., Forty-eighth [illegible] and Halsted St., Chicago, Ill.
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINES (Electric)
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

MINE SIGNALS
American Mine Door Co., Canton, Ohio.

MOTORS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.

NITROGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

ORE, BUYERS AND SELLERS OF
Irvington Smelting & Refining Works, Irvington, N. J.
Phelps-Dodge Corporation, New York City.

OXYGEN GAS
Linde Air Products, 30 East 42nd St., New York City.

OXY-ACETYLENE APPARATUS and SUPPLIES
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PATENT ATTORNEY
John Boyle, Jr., Ouray Bldg., Washington, D. C.

PERMISSIBLES, Explosives
du Pont Powder Co., The E. I., Wilmington, Del.
Hercules Powder Co., Wilmington, Del.

PICKING TABLES
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

PIPE (Wood)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PNEUMATIC TOOL
Ingersoll-Rand Co., 11 Broadway, New York City.

POWDER, BLASTING
E. I. du Pont de Nemours & Co., Inc., Wilmington, Delaware.
Hercules Powder Co., 934 King St., Wilmington, Del.

POWER TRANSMISSION MACHINERY
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

PREHEATING APPARATUS
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

PROSPECTIVE DRILLS
H. R. Ameling Prospecting Co., Rolla, Mo.
Hoffman Bros., Punxsutawney, Pa.
Ingersoll-Rand Co., 11 Broadway, New York City.

PULLEYS
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

PULVERIZER SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

PULVERIZERS, COAL AND COKE
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

PUMPS, AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, CENTRIFUGAL
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, MINE
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS (Electric)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Aurora Pump & Mfg. Co., Aurora, Ill.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS (Gathering or Dip)
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

PUMPS, PNEUMATIC AIR LIFT
Ingersoll-Rand Co., 11 Broadway, New York City.

PUMPS, POWER
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, SAND
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, STEAM
Ingersoll-Rand Co. (A. S. Cameron Steam Pump Works), 11 Broadway, New York City.

PUMPS, VACUUM
Ingersoll-Rand Co., 11 Broadway, New York City.

QUARRYING MACHINERY
Ingersoll-Rand Co., 11 Broadway, New York City.

RAIL BONDS
American Steel & Wire Co., Chicago and New York.
Ohio Brass Co., Mansfield, Ohio.

RAILWAY SUPPLIES
Ohio Brass Co., Mansfield, Ohio.

REGULATORS, Welding, Compressed Gas
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

REK-TANG ROLLED SLOT SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

RETARDERS
Mining Safety Device Co., Bowerston, Ohio.

RIDDLE WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

ROCK-DISPOSAL EQUIPMENT
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

ROCK DRILLS
Ingersoll-Rand Co., 11 Broadway, New York City.

ROCK DUSTING MACHINES
Diamond Machine Co., Monongahela, Pa.

RODS, WELDING
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

ROLLER BEARINGS
Hyatt Roller Bearing Co., Harrison, N. J.

ROLLS (Crushing)
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

ROPE
American Steel & Wire Co., Chicago and New York.

ROPE, TRANSMISSION
American Steel & Wire Co., Chicago and New York.
Roebling Sons, John A., Trenton, N. J.

ROPE, WIRE
American Steel & Wire Co., Chicago and New York.
Roebling Sons, John A., Trenton, N. J.

ROTARY DUMPS
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

SAFETY APPLIANCES, MINE
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.

SAFETY HORN CAR STOPS
G. M. Johnson Mfg. Co., Jeannette, Pa.

SCRAPER LOADERS
Goodman Mfg Co., Halsted St. and 48th Place, Chicago, Ill.

SCREEN WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

SCREENS, HORIZONTAL
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.

SCREENS, REVOLVING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS, SHAKER
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

SCREENS AND PERFORATED SHEETING
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SHARPENERS, DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.
Sullivan Machinery Co., 122 S. Mich. Ave., Chicago, Ill.

SHORT WALL ANCHORS
Amer. Mine Door Co., Canton, Ohio.

SIEVE WIRE CLOTH
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

SIGNS (Mine)
Stonehouse Signs, Inc., 842 Larimer St., Denver, Colo.

SILENT CHAINS
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

SINKERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

SKIPS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Connellsville Mfg. & Mine Supply Co., Connellsville, Pa.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SKIP LOADING EQUIPMENT
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.

SMELTERS
Irvington Smelting & Refining Works, Irvington, N. J.

SPECIAL MACHINERY
Fawcus Machine Co., Pittsburgh, Pa.

SPEED REDUCERS
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SPEED REDUCERS, TRIPLE
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

SPEED REDUCERS, DOUBLE
Fawcus Machine Co., Pittsburgh, Pa.
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

SPEED REDUCERS, SINGLE
Fawcus Machine Co., Pittsburgh, Pa.

SPLICE, CABLE
American Mine Door Co., Canton, Ohio.
Ohio Brass Co., Mansfield, Ohio.

SPLICE, INSULATOR
American Mine Door Co., Canton, Ohio.

SPLICE, TROLLEY WIRE
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

SPLICERS, TROLLEY
Amer. Mine Door Co., Canton, Ohio.

SPROCKETS
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

SPROCKETS, COMPENSATING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPROCKETS, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

SPROCKETS, SPRING
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

SPUR GEAR DRIVES
Fawcus Machine Co., Pittsburgh, Pa.

SPUR REDUCERS
Foote Bros. Gear & Machine Co., 215 N. Curtis St., Chicago, Ill.

STAMP MILL SCREENS
Ludlow-Saylor Wire Co., 608 S. Newstead Ave., St. Louis, Mo.

STEEL, ALLOY
Central Steel Co., Massillon, Ohio.

STEEL, HIGH FINISH SHEET
Central Steel Co., Massillon, Ohio.

STEEL, HOLLOW & SOLID DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STEEL, REINFORCING
American Mine Door Co., Canton, Ohio.

STEEL, STRIP
Central Steel Co., Massillon, Ohio.

STOPERS, ROCK DRILL
Ingersoll-Rand Co., 11 Broadway, New York City.

STORAGE BATTERY LOCOMOTIVES
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.

SWITCHBOARDS, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

SWITCHES (Disconnecting and Electric)
General Electric Co., Schenectady, N. Y.

SWITCHES AND FROGS, TROLLEY
American Mine Door Co., Canton, Ohio.
Central Frog & Switch Co., Cincinnati, Ohio.
Ohio Brass Co., Mansfield, Ohio.

TIES, (Steel, Mine)
Central Frog & Switch Co., Cincinnati, Ohio.

TIMBER PRESERVING EQUIPMENT
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TIPPLES
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.

TIPPLE EQUIPMENT
Car-Dumper & Equipment Co., Grand Crossing, Chicago, Ill.
The Jeffrey Mfg. Company, 958-99 North 4th St., Columbus, Ohio.
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Roberts & Schaefer Co., Wrigley Bldg., Chicago, Ill.
Weller Mfg. Co., 1820-56 N. Kostner Ave., Chicago, Ill.

TORCHES, Brazing, Carbon Burning, Cutting, Lead Burning, Welding, Welding and Cutting
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TRACKS, PORTABLE, RAIL, ETC.
Central Frog & Switch Co., Cincinnati, Ohio.
West Virginia Rail Co., Huntington, W. Va.

TRACK, (Portable, Assembled and Unassembled, Riveted or Bolted),
Central Frog & Switch Co., Cincinnati, Ohio.

TRACK SUPPLIES
Central Frog & Switch Co., Cincinnati, Ohio.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TRANSMISSION, SILENT CHAIN
Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.
Morse Chain Co., Ithaca, N. Y.

TROLLEY FROGS
Ohio Brass Co., Mansfield, Ohio.

TROLLEY (Hangers and Clamps)
General Electric Co., Schenectady, N. Y.
Ohio Brass Co., Mansfield, Ohio.

TROLLEY MATERIAL, OVERHEAD
Ohio Brass Co., Mansfield, Ohio.

TROLLEY WHEELS AND HARPS
Goodman Mfg. Co., Halsted St. and 48th Pl., Chicago, Ill.
Ohio Brass Co., Mansfield, Ohio.

TRUCKS, WELDER'S
Oxweld Acetylene Co., 30 E. 42nd St., New York City.

TURBINES, HYDRAULIC
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

TURBINES, STEAM
Allis-Chalmers Mfg. Co., Milwaukee, Wis.

VALVES
Ohio Brass Co., Mansfield, Ohio.

VALVES, Back Pressure, Pressure Reducing
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Walter C. Browning, Cons. Engr., 1215 Pacific Mutual Bldg., Los Angeles, Calif.
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Dr. F. W. Sperr (*Chairman*), Professor of Civil and Mining Engineering, Michigan College of Mines, 315 Florence St., Houghton, Mich.
C. L. Berrien, Genl. Supt. of Mines, Anaconda Copper Mining Co., Butte, Mont.
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D. F. Holtman, Asst. Director, National Committee on Wood Utilization, Department of Commerce.
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H. B. Fernald, Loomis-Suffern & Fernald, 50 Broad St., New York City.
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Falcon Joslin, 2203 L. C. Smith Bldg., Seattle, Wash.
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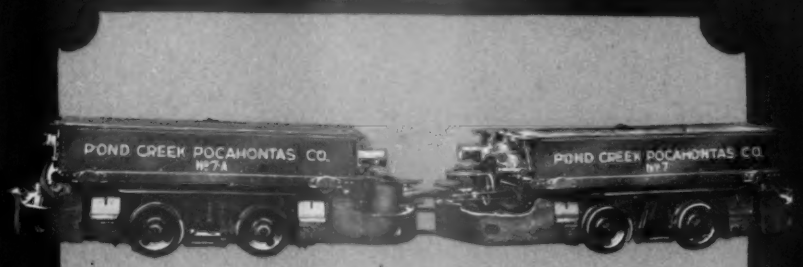

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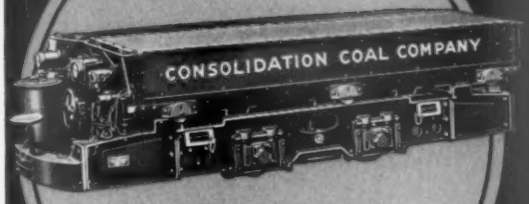

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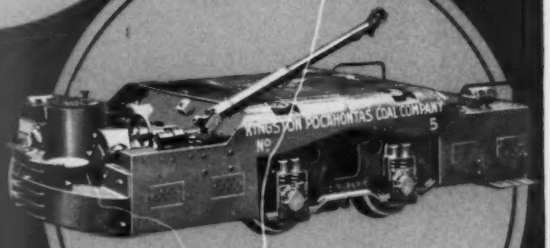

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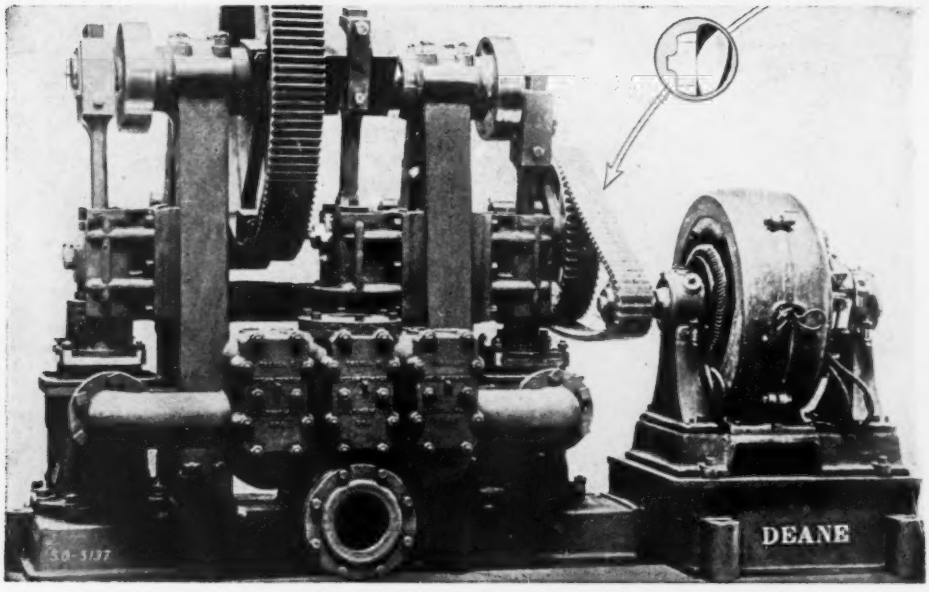

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